THE

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CONTENTS:

	PAGE
The Inventor: His Methods and Remuneration	117
The World's Cables	119
Electric Traction	119
The Cowper-Coles Electro-Zincing Process (*illustrated*) ...	119
Tœpler's High Frequency Experiments	122
Still They Come!	123
Correspondence:—	
Explosions in Underground Mains	123
Local Action in Accumulators	124
Electric Light Photography	124
Notes	124
Three Central Electric Light Works:—	
The Halifax Works (*illustrated*)	129
The Nottingham Works (*illustrated*)	134
The Dewsbury Works (*illustrated*)	135
Business Notices, &c.	137
Contracts Open and Closed	141
City Notes	141
Traffic Receipts	142
Share List of Electrical Companies	143
New Sources of Electric Power	144
Proceedings of Societies:—	
The Institution of Electrical Engineers (*illustrated*) ...	144
New Patents	147
Abstracts of Published Specifications	148

THE

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THE INVENTOR: HIS METHODS AND REMUNERATION.

"INVENTORS seem very much alike as a caste. They talk loudly, especially about 'conspiracies of monopolists;' they beat upon the table with their fists; and they secrete fragments of their inventions about their persons." In this way does Mr. Rudyard Kipling express matters in one of his "Plain Tales from the Hills;" and we are not sure that he does not succeed in approximating very closely to the truth, until on further consideration it appears that the vagaries of individuals often obscure the sterling qualities of the class and hinder a just judgment from being formed.

In contradistinction to Mr. Kipling's views, we have Mr. Eustace Carey, the Chairman of the Liverpool Section of the Society of Chemical Industry, dividing the genus inventor into several well-marked species or groups. There is, first, the practical manufacturer, who, with command of capital, experience, and the assistance of experts, works out a new idea to a finish, ending in its adoption or definite abandonment. He is typical of a class of inventors who, when they possess capacity and perseverance, cannot fail to be of great service to the community. But even men of this class, and celebrated men, too, have not been able always to restrain themselves from the weakness of inventors of a commoner type; they have, parenthetically, as it were, run to the Patent Office to secure the protection of immature notions and half-fledged ideas which have occurred to them during their work on the main and particular invention which they have had in hand. In fact, the very best of inventors, however practical and experienced they may be, seem to be sometimes victims of a disease which may not, inaptly, be termed inventors' mania: the spirit of invention invades them, ideas, good, bad and indifferent, seize upon them, till writing specifications and paying patent fees becomes an almost daily excitement, without which life seems to them flat and uninteresting.

Manufacturers and capitalists who belong even to the best class of inventors are not always an unmixed blessing to their partners or to the firms to which they belong. They are apt to pursue will-o'-the-wisps, and to neglect steady attention to every-day business or common-place improvements. A manufacturer or managing partner of a works, who has his eyes open to perceive the small additions or alterations which may improve or cheapen production, and has also his mind open to accept suggestions from his colleagues and his workmen as to the never-ending improvements which can be made in details, is frequently a wiser man than his compeer who has a genius for revolutionising everything. An inventive partner often gradually becomes a perfect terror to his friends.

There is another class of inventor, comprising those who are not engaged in manufacture, some of them men of sound

scientific knowledge, and possibly of some technical experience, but who cannot afford, themselves, to make a large scale experiment, or cannot create a value for an invention by the expenditure of sufficient capital. So they call in an expert. They want a large sum for the invention, and hence their next step is to interview a company promoter. Presently the inevitable prospectus makes its appearance, embellished with "the favourable opinion of a well-known scientific expert," who solemnly states that "from the interesting and successful experiments which he has been permitted to witness, and from a careful examination of all the conditions, and assuming that the large scale results bear out the experimental trials, which he sees no reason to doubt, then the prospects of the company are brilliant in the extreme."

One of the most tiresome types of inventors is he who is unwilling to take any further risk of his invention, but demands from the practical manufacturer to be at once remunerated to the full value of his own estimated profit to be made in the unexpired portion of the 14 years' life of his patent. Now, while it is difficult to fairly guess the possible profit to be gained by an invention, it is still more difficult, well nigh impossible, to capitalise it. To make such a venture, except at very short purchase, say two or three years, is almost equivalent to gambling, if a company be formed to acquire the new patent, and a large amount be paid in cash. If, in a manufacture, finality could be reached, and a certainty thus arrived at that the patent to be acquired would not be superseded in the course of a few years, such payments to inventors might be justified; but when we remember that a money-making invention is just the one to attract the attention of inventors all the world over, the payment of a large sum is unwise. Most inventors insist on a payment of a certain amount of cash: the most prudent are those who are satisfied with a small amount, and are content to accept a share interest in the venture.

That type of inventor, the dealer in secrets, is a power in the world, too, since it is a common weakness of human beings to be charmed by the unknown, almost in direct ratio to its approach to the impossible, as witness electric sugar. Whenever a thing is to be kept a secret until a purchaser has satisfied himself that it will work, we might almost at once dismiss it, for if it is a patentable invention there is no secret necessary, and if not patentable, there is no guarantee to the purchaser that the invention may not be worked by others.

Having mildly pilloried the chief types of inventors, it behoves us to say something respecting the direction in which a man, desiring to place something new before the commercial world, should seek his due remuneration. We may at once leave out of consideration the members of our first group of inventors, viz., those who are capitalists and manufacturers, since they will work out their ideas in their own way and for their own profit, as is, of course, becoming. The remaining groups may be taken *en masse*, since they really resolve themselves into a set who have not the means with which to exploit their notions. Sometimes—and, indeed, very often—these are mere outsiders, or to speak more euphemistically, laymen; more frequently they are the *employés* of manufacturers. These, it seems to us, should look to reasonable royalties for their rewards, unless they are prepared to accept a small sum to reimburse them for their preliminary outlay, followed by a moderate share interest in the company that is formed to run their invention. If this plan were more uniformly adopted, one of the causes of over-capitalising would be eliminated, and the venture would be more likely to enjoy commercial prosperity. We remember that when the Patents Committee of the House of Commons was investigating, amongst other related matters, the payment of inventors, it was suggested that the royalty system should not only be advised, but that a clause should be introduced into any patent Act that should bind the patentee to give his invention to the public on payment of royalties to be assessed by some impartial tribunal. It is certainly a subject which might be considerably advantaged if it received a little prudent legislation.

The Old and the New.

A REMARK which emanated from the secretary of the Institution of Junior Engineers on Saturday evening last, during the after-dinner speeches, appears to have some bearing upon a young society connected with the electro-technical industry. Mr. Dunn deprecated an idea which seemed a little prevalent that the Institution of Junior Engineers acted in any way antagonistic to the older societies, or that it had any intention of so doing, and this brings us to the relations which we think should exist between the Institution of Electrical Engineers and the Northern Society of Electrical Engineers. The presidential addresses of both Mr. Crompton in London, and Mr. Henry Edmunds in Manchester, had, curiously enough, much in common, although neither had the slightest knowledge that they would be trenching on the same ground. The Northern Society is full of energy and in a flourishing state; its members are able, enthusiastic, and hard working men, who can send in good, interesting, and really valuable papers for reading and then discuss them in a manner which can only be the outcome of long experience. We do not suppose for a moment that the Manchester Society will ever set itself in opposition to the parent Institution, but it may not be an inopportune moment to throw out a hint that the Council of the Institution might take steps, if such a proceeding has not already suggested itself, to foster amicable relations between the two. An annual re-union, an exchange of papers, or any means of entering upon a cordial relationship with, and a recognition of, the new society, would, we feel sure, commend itself to the members of both. Having made the suggestion, we leave it for those who have the interests of electrical engineers under their fatherly care and control to take it into consideration.

What Does It Mean?

AS we briefly announced in the last issue of the REVIEW, Mr. Frank Bailey has been appointed chief engineer to the City of London Electric Company; such an appointment carries with it no great surprise, save, perhaps, that occasioned by the unexpected discrimination which the City Company has shown in its choice of an engineer. There is one fact, however, that we find a difficulty in appreciating, Mr. Bailey still retains the position of engineer to the Metropolitan Company. What does it mean? The dual appointment naturally forms ground for a good deal of conjecture; indeed, many rumours of possible amalgamation of the two great electric light companies have been flying about during the past few days. We cannot, of course, say whether there is anything in these persistent rumours; some say rumour is a notorious liar while others hold that usually it contains a substratum of truth. We are not reflecting in anywise upon the worthy chairman of the Metropolitan Company when we say that he has carried out some wonderful combinations in his day. However, time alone will show, for fearing to have some cock-and-bull story given to us, we do not care to make enquiries.

THE WORLD'S CABLES.

The *New Science Review*, recently published, contains an article under the above heading. In one part it speaks of Atlantic cables as though they were the only cables laid, and refers to the fact of Messrs. Siemens Bros. having laid eight of the eleven existing Atlantic cables, instead of giving the proportion of cable laid by that firm out of the whole which have ever been laid in the Atlantic and elsewhere.

The article then professes to describe the art of cable manufacture. An alternating current urged by a 5,000 volts E.M.F. is not *usually* applied to the core as suggested, but a continuous voltaic current with about 500 volts at the back of it.

The writer makes the common mistake of many "popular" writers, of speaking of a twisted strand or sheath. In engineering work wires are never intentionally twisted (no more than they are "kinked" intentionally), but are "laid up" together in the form of a strand. With reference to the last Commercial cable, the article says :—"In the neatness with which the work was done and its freedom from mishap, this laying of the eleventh Atlantic cable formed a striking contrast to the laying of the first, and may be taken to demonstrate that the science of cable laying has reached almost the acme of perfection."

From the above, one might be led to suppose that the writer considers the laying of recent Atlantic cables more wonderful than the laying of the first deep water cable, which also stretched across the Atlantic. If so, we cannot agree with him, especially when the fact is remembered that the general principles adopted are precisely the same as those which were especially evolved for the first Atlantic cable.

We venture to think there is no branch of engineering which has so rigidly been kept in the lines set forth by the early workers as in telegraphs.

In the first Atlantic expedition, the disadvantages of a want of accurate methods of electrical testing had to be contended with, besides the still greater disadvantage of the inferiority of the article to be tested, owing to the lack of experience in the manufacture of the core as well as of the cable.

Notwithstanding this, from an engineering point of view, the work was carried out successfully, and with cable machinery, in the shape of friction brakes, dynamometer, &c., especially designed for the expedition, of the same character as we still, even now, adopt.

ELECTRIC TRACTION.

The description and discussion of American street railways operated by electrical energy is still carried on in *Engineering* by Mr. Philip Dawson, and chiefly from the commercial side, he goes into great detail. The figures quoted are already familiar, and show what we have always contended is correct, namely, that electric traction on the trolley plan pays better, and is a much more satisfactory method of traction than any other for street railways. Efficiency or no efficiency, the fact remains, as proved by experience, that it is better than any other power, whether horse or mechanical.

We do not believe that any serious difficulties would be met with in introducing the trolley line into this country, if capital could be found to invest in street railways, and their electric equipment. Our electrical engineering manufacturers are all prepared to equip lines on the most approved engineering principles, and as far as perfect motors, generators, regulators, and other essentials are concerned, we believe British engineers can turn out superior articles at less cost than foreign firms.

The attempt to introduce American machinery for electric traction, is creditable to American enterprise, but hopelessly ineffectual; in the first place because capital cannot at present be found for electric traction schemes, and in the second place if capital could be available for such purposes, the British machinery would be found not only cheaper but of better design and construction than anything American in the dynamo and motor line.

The objection to trolley lines is not very real; it seems strong, because of the weak forces hitherto brought to bear against it. But if the conditions were such that a real demand for electric power on our street railways would arise, and capital were subscribed in large amounts for its introduction, the objections to the overhead trolley would be swept aside like cobwebs. The root of the evil, tardiness in electric traction in this country, lies neither in the want of ability to engineer and equip lines, nor altogether in the objection to trolleys. There is simply no pressing need for a change where street railways already exist, that is so far as those who control them can see, and, where no street railways are in use, there will be found either that some prohibitive circumstances are in the case, which would keep out any system of mechanical traction, or that a street railway would not pay in any case.

Electric traction must proceed successfully, but in view of the tens of thousands of pounds squandered on electrical matters, we might say hundreds of thousands of pounds wasted, electrical engineering schemes are not supported as they might have been.

Another thing is worth noting, there are no master patents controlling electric traction machinery in this country; and, as Mr. Swinburne says about investing in electrolytic companies, "The wild inventor with patents seems necessary." Of course we know that patents for electric traction machinery are innumerable, but none of them are controlling patents; few are of any value whatever, and these few cover only some small details. These facts should, however, all tend to favour the investor in street railways, for there being no monopoly in the machinery, it can be bought in the open market all the cheaper and also better, for competition not only cheapens, but, up to a certain point, improves manufactures.

Capital is not required to foster the manufacturing branch of electric traction, for plenty of firms with any amount of capital are prepared for that; what the capital is wanted for, is to purchase and work electric plant for street railways; and the problem before us is how are we to induce the capitalist to invest in this line of business? The facts and figures regarding American street railways are valuable for this purpose, as tending to convince people of the profitable working of trolley lines.

THE COWPER-COLES ELECTRO-ZINCING PROCESS.

In previous issues we have from time to time noticed plants erected under the Cowper-Coles system for electro-zincing the frames and skin plates of torpedo boats and torpedo boat destroyers. A large plant has recently been completed for Messrs. Maudslay, Sons & Field, especially designed for galvanising the tubes of water-tube boilers. To test the adhesion of the zinc applied by the Cowper-Coles process, tubes have been jumped down to less than a quarter of their length, when the zinc was found to be intact, and a steel pipe, heated in a sand bath to a temperature of 600° F., on being removed from the hot sand, showed no signs of blistering. The capacity of the dynamo at Messrs. Maudslay, Sons & Field's plant is 3,000 ampères, at an E.M.F. of 5 volts. The current is conveyed to the tanks by two stranded cables, having a total sectional area of three square inches, all the connections being Glover's solid welded ends. One of the interesting features of the Cowper-Coles improved process is that zinc anodes are dispensed with, the bath being kept up to its best working strength by means of zinc in a very fine state of division, kept in suspension in the electrolyte.

Fig. 1 shows the general arrangement of a plant erected at the Thames Iron Works and Shipbuilding Company, Limited, Blackwall, the total capacity of the zincing tanks being 14,000 gallons: the tanks are constructed of steel and lined with wood, the length of the tank being 30 feet, which is sufficient to allow the frames and angles of torpedo boat destroyers to be zinced at one immersion. Fig. 2 shows the general arrangement of the switchboard, the output of the dynamo, which is a four-pole one, and shunt wound, being 2,000 ampères at an E.M.F. of 5 volts. The dynamo

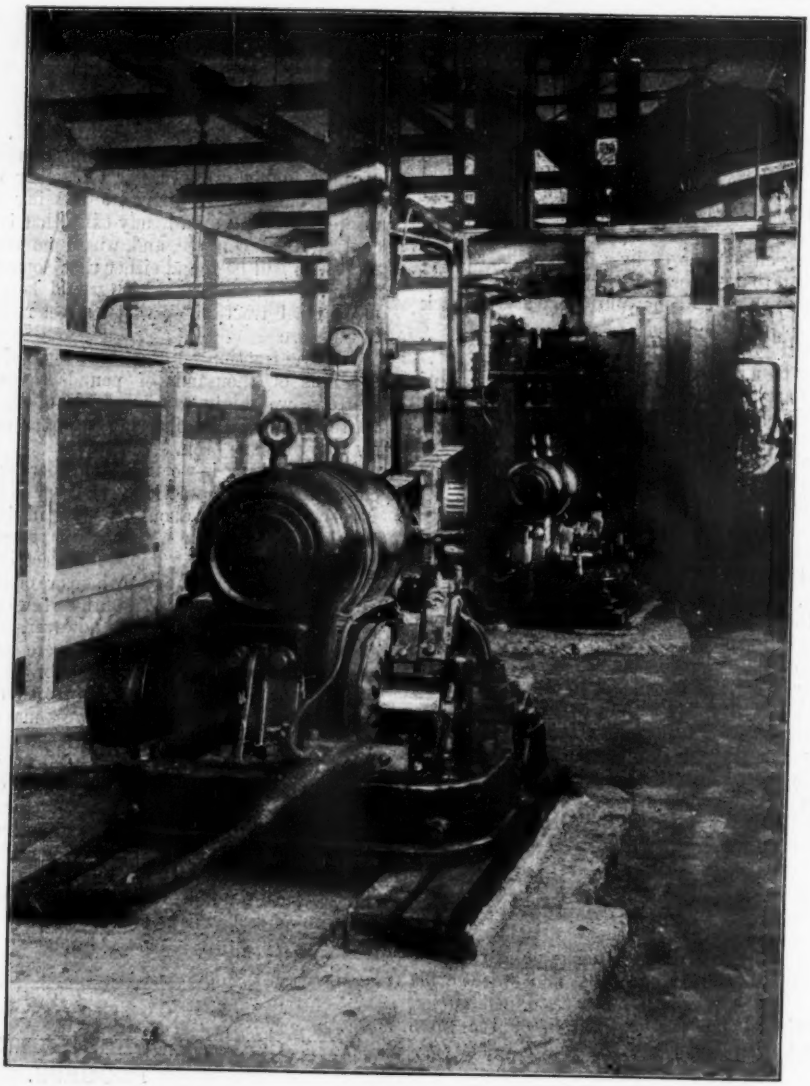


Fig. 4.

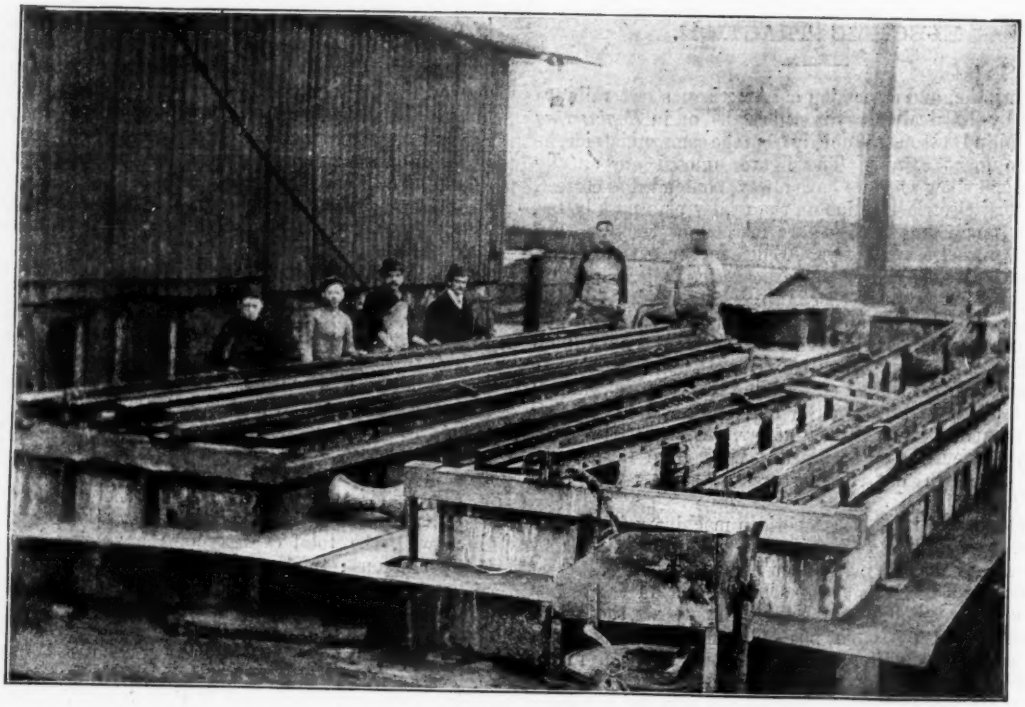


Fig. 1.

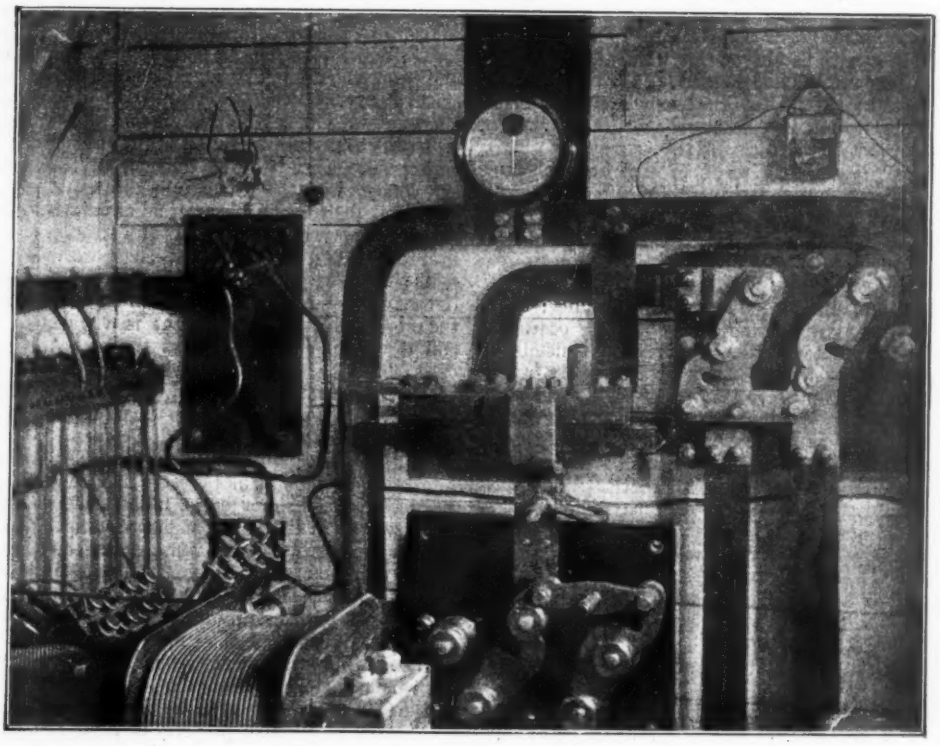


Fig. 2.

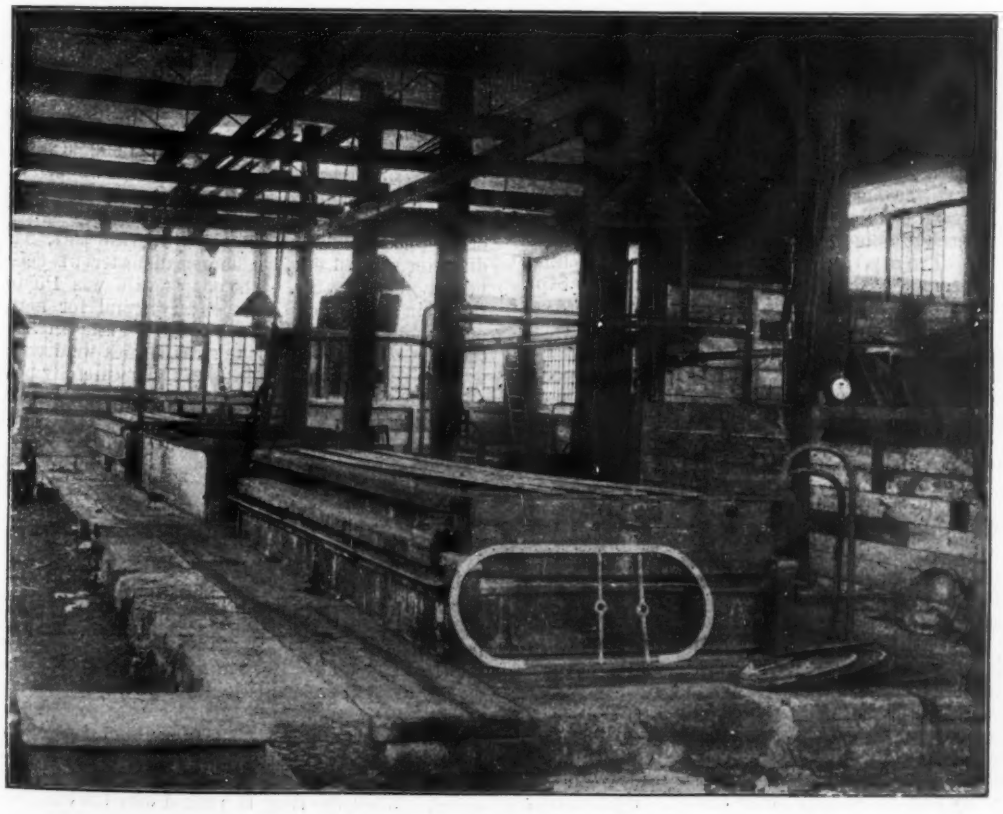


Fig. 3.

is driven by an electric motor coupled direct, the motor being supplied with current from the central electric light station in the works.

Arrangements are made for working the tanks in series or parallel, according to the nature of the work under treatment. One of the great impediments to the reduction of zinc on a commercial scale has been the tendency of the zinc, after depositing in a negative state for a short time, to come down in one of the various forms of the spongy deposits. Mr. Cowper-Coles, after a long series of experiments, has overcome these difficulties in a cheap and effective way.

The Cowper-Coles process is being largely employed for zinc flushing, which is distinctive from zinc plating, or cold galvanising, inasmuch as, in the first case, the zinc coating consists only of a few pennyweights of zinc per square foot, in the second case of 1 or 2 ounces for equal area; the former corresponding to a priming or intermediate coating for painting upon, the latter being an unprotected metallic coating. The extra durability obtained by thoroughly freeing the surface to be painted from all scale and oxide is considerable. Ironwork after pickling, even when well washed and dried, is quickly coated with a film of oxide, which reduces the adhesion of the paint, and causes electro-chemical action and the consequent flaking of the paint. It is found that a perfectly clean surface can be retained for painting upon until such time as the paint can be applied, by giving the working a thin coating of zinc directly after pickling.

Figs. 3 and 4 show a plant erected at Messrs. Laird Bros.' shipbuilding yard, Birkenhead, which has recently been remodelled and re-erected in more commodious premises. Two dynamos worked in parallel supply the current at an E.M.F. of 5 volts.

A plant has been erected at the works of Messrs. Watson, Laidlaw & Co., of Glasgow, in which a reversing switch, designed to carry a current of 2,500 ampères for reversing the current during the operation of pickling, is used, but this operation has been supplanted by a more economical system, which we hope to describe in detail at a future date.

It is satisfactory to learn in the face of the developments in this kind of work to which we alluded in the City columns of our last issue, that Mr. Cowper-Coles has been for some considerable time practically carrying out the operations now contemplated by others.

TŒPLER'S HIGH FREQUENCY EXPERIMENTS.

Dr. Tœpler, of Dresden, the inventor of a well known type of the influence machine, has recently succeeded in reproducing most of Tesla's experiments with two large multiple influence machines, one of 20 plates, and the other of 60 plates.* The experiments with the 20-plate machine were shown before the Naturforcher-Versammlung on September 27th; those with the 60-plate machine were shown before the "Isis" Society at Dresden on July 12th. Before the former machine required to drive it about $\frac{1}{16}$th to $\frac{1}{18}$th-H.P., the latter about $\frac{1}{8}$th-H.P. The effects obtained only differed in degree; with the larger machine they were, of course, more brilliant, and, in fact, fell very little short of those obtained by Tesla with a dynamo consuming several horse-power. The experiments with the 60-plate machine only will be described.

The high frequency currents were obtained from the outer coatings of two Leyden jars, whose inner coatings were connected to the electrodes of the influence machine. The electrodes of the machine were adjusted to give a spark gap of 3 mm. The Leyden jars were of medium size, and such that the machine gave 100 of the 3 mm. sparks per second. The inner coating of one of the Leyden jars being connected to one pole of the machine, and the inner coating of the other jar to the other pole, the jars were charged and discharged before and during the passage of each spark, that is to say, 100 times per second. Corresponding oscillatory currents were produced in the circuit connecting the outer coatings of the jars. The experiments were made with the high frequency currents in this outer circuit. By inserting the primary circuit of a transformer in this circuit, the high frequency currents were transformed down or up.

* *Zeitschrift für Elektrotechnik*, xii., pp. 595—617.

The chief advantages in using the influence machine for the demonstration consist in this direct production of a high tension, high frequency alternating current, which can then, as required, be transformed either to a higher tension or a lower; and in the almost perfect symmetry of the positive and negative currents which prevents the accumulation of a static charge in the outer circuit. On account of the short length of the spark gap, there is no tendency for the stream of sparks to degenerate into a brush discharge. To this circumstance, perhaps, is due the comparative success of the experiments with the influence machine.

That the current in the external circuit is oscillatory, can be easily shown by experiment. If a Geissler tube is inserted into this circuit, it shows the so-called cathode light on both poles; this is explained by the fact that cathode and anode light are formed in rapid succession on both poles, but only the more brilliant cathode light is visible. A Rhumkorff coil discharge, of course, shows the cathode light only on one pole.

An experiment was arranged to show the enormous resistance offered by self-induction to the passage of high frequency currents. A piece of copper wire, 8 mm. thick, and 40 cm. in length, was bent into a U-shape. A glow lamp, having a resistance 100,000 times greater than the bent copper wire, was inserted as a shunt between its ends, which were then connected up in the high frequency circuit. Notwithstanding the enormously greater resistance of the lamp, it becomes brightly incandescent. If a band of thin copper sheet (0·1 mm. thick) is bent into a U-shape, and slipped over the bent wire, with an inward spring to hold it close to the wire, the brightness of the lamp is reduced in a remarkable degree. This curious result confirms the theory that high frequency currents flow on the surface of conductors only, and do not to any extent utilise the interior section.

Another remarkable property of high frequency currents is their behaviour towards masses of iron. It is well known that, in the case of low frequency currents, the insertion of iron wire into a transformer increases the inductive effect of the primary upon the secondary. With the high frequency currents the reverse is the case. If a transformer be made with ten turns in the primary and three in the secondary, and excited by the Tœpler arrangement, when an iron core is inserted, a brightly glowing lamp in the secondary circuit is almost extinguished. It is necessary in these experiments to use 6 to 10-volt lamps, as otherwise the jerks produced by long sparks in the carbon thread lead to their rapid destruction.

A series of experiments were made with transformers built up in different ways from four bobbins with different numbers of turns, made as follows:—Two pairs of cylindrical glass shades were selected, so that one of each pair could fit into the other, after the requisite number of turns of wire had been wound on the cylindrical part. The smaller diameter was 26 cm., the larger diameter 31 cm., and the height about 18 cm. The copper wire was 1·5 to 2 mm. thick (in the case of the secondary spiral for high tension only 1 mm.) and covered with thick gutta-percha. Before the wire was wound on, the glass shades were covered with wax, and after the winding, wax was carefully poured over all the turns. The terminals were protected from side discharges by interposing plates of mica. The following is a list of the different coils, with dimensions:—

Coil	I.—26 cm.	diameter.	2	mm.	thick	wire,	3	turns.
„	II.—31 „	„	2	„	„	„	3	„
„	III.—26 „	„	2	„	„	„	28	„
„	IV.—31 „	„	1	„	„	„	64	„

It can be shown that a considerable mechanical repulsion exists between the turns of the primary and secondary spirals in these transformers. If an aluminium ring is suspended by a silk thread from a spring balance over the upper end of the vertical coil IV., it will, under the influence of the condenser oscillations, be lifted to a considerable extent.

If a simple copper ring of 8 mm. thickness, with a 5-candle lamp in circuit, is held over coil III., the lamp will light up when the ring is still 10 cm. above the primary spiral. When the ring is pushed over the coil, the lamp is heated to whiteness, and almost burnt up.

If coil III. is used as primary, and coil II. as secondary, the secondary current cannot be felt, and gives a scarce

perceptible spark. When the secondary current is sent through two graphite rods, the lower one of which has a flat end on which the sharp point of the upper one rests, a sort of small arc light is produced. The same arrangement of coils suffices to bring a glow lamp with a 12 cm. filament to full incandescence. The same transformer gives a dazzling bright light with the Aron mercury arc lamp.

The above interesting results were obtained by transforming down the condenser oscillations, but essentially more interesting phenomena were exhibited by transforming up. If coil II. is used as a primary and coil III. as a secondary, the tension thereby obtained, especially if high tension condenser oscillations are employed in the first place, will be enormous. With this arrangement, the electrical brushes shown in Tesla's experiments can be easily produced.

With III. as a primary and IV. as a secondary, a Geissler tube held in one hand by an insulated person grasping one terminal of the secondary with the other hand, can be lighted up; the other terminal of the secondary must be put to earth. Also with this arrangement Tesla's unipolar lamp with the carbon button can be lighted up. The well known negative physiological effects of the high frequency currents can likewise be shown. A glow lamp with a 2 cm. filament can be lighted up by a current passing through the human body without any sensation being experienced except at the places of entrance and exit. If the connections with the body are made by dipping the hands in salt solutions, no sensation whatever is experienced.

Another peculiar property possessed by certain oscillatory streams of sparks may be of some value to physiologists. These sparks give off in their neighbourhood, in spite of their high intensity, very little heat. This effect is best shown by sparks produced in a gap which forms a shunt with a spiral of 20 turns, 5 cm. diameter, and 2 mm. thick wire, placed in the outer circuit of the two Leyden jars. The sparks obtained are as bright as those in the principal spark gap. If the sparks do not exceed 0·3 cm. in length they can be grasped firmly for a long time between two fingers, so as to render the muscles and tissues visible, without more than a moderate degree of warmth being felt. This intense stream of sparks, passing between the ends of the two parallel wires, may be used to illuminate the cavity of the mouth, without any danger of burning. In the latter experiment the spiral may be replaced by a suitable fluid resistance.

Tesla's experiments, by which he showed that disconnected vacuum tubes placed in a space agitated by the high frequency waves can be illuminated, may also be shown by Tœpler's apparatus; also all the phenomena of the so-called Crookes's tubes, such as phosphorescence, fluorescence, &c. The effects obtained by Tœpler with the large multiple plate influence machine were much greater, in proportion to the horse-power expended, than those obtained with an alternating current dynamo.

STILL THEY COME!

We have every reason to believe that before long another primary battery is likely to be brought before the public. As with the "great electrical discovery" to which we referred last week, we shall no doubt be told that this new comer is expected to revolutionise present electric lighting systems, and that it is a thousand times superior to anything ever before invented. This battery has been protected in two new patents for which applications have lately been made. As to the details of the apparatus we are so far in the dark, but from what has come to our ears it is being schemed by two men from the midland counties, who, in their former handicrafts have had no very close connection with electrical work and scientific research. Such is the class of men who are from time to time identified with "great electrical discoveries," which the general public are told are 19th century wonders, but which expert technical men declare to be as "old as the hills." We do not say that this new battery is a copy of others, but we have reason for believing that there is little novelty or newness in it.

No printed prospectus has yet, so far as we are aware, been circulated, but the "inventors" are, we believe, busy endeavouring to secure promises of financial support from acquaintances. From what we have said our readers will now be prepared for these gentlemen should they come across them.

When there is a report issued or a prospectus published, we shall, according to our usual custom, lay the details before our readers, along with our impartial opinion of the battery.

CORRESPONDENCE.

Explosions in Underground Mains.

In your issue of 11th ult., you were good enough to publish a letter of mine on this question, and I would not trouble you again but for Mr. Gilbert's letter in your current number, which is, I am afraid, likely to lead us from the point at issue. In my previous letter I gave suggestions which, if properly carried out when constructing new mains, would completely prevent explosions. These suggestions, with slight modifications, could be applied to almost any of the systems of mains which are being laid. It seems to me ridiculous to condemn bare copper, or any other kind of mains, simply because proper care and attention has not been given to them at the time of construction; besides, the majority of the accidents have not been due to the conductors being of naked copper. Many of them have happened on systems where insulated cables have been used entirely, and those which have occurred in the bare copper strip mains have, in the majority of cases, been traced to the "potential wires," which have been of insulated cable. It is not necessary to have a "short" between the mains to cause a spark; a slight leak is quite sufficient, and it is the "slight leak" which gives the trouble. It is much easier to prevent "shorts," which, in fact, seldom happen, and then generally through accident, than it is to avoid the leak.

The point which we have to deal with now is to prevent these accidents happening again in mains already in use. We want the quickest, cheapest, and most effectual way of dealing with it, and that is not by adopting a new and untried system. The owners of mains would never for one moment consider the question of abandoning them entirely for a new system; the expense would put it out of the question, to say nothing of the great public inconvenience and the time occupied, during which many more accidents might happen in the existing mains. If the corporations, vestries, and companies owning mains not yet properly drained and ventilated would take up the question seriously, they would find little difficulty in dealing with it, and the expense (if put in proper hands) would be little compared to what further explosions might lead to. With your permission I will suggest a way of doing this. Taking the question of drainage first, this refers principally to conduits or "drawing-in" systems, and as many of these when constructed were not laid to proper falls, it is necessary to find out the places where water collects, and at these points construct a pit at the side of the mains of brickwork or other suitable material, into which the water can drain. The size of the pit would be governed by the quantity of water to be dealt with, which will vary at different points. The cover might be a lid of cast-iron, and need not be large. I have fixed some with covers 12 inches square, which have not been at all objectionable; but for all that they could, if necessary, be smaller. If it were found that the levels of the mains were such that to do this would mean the construction of too many pits, I would connect several of the lowest points with small drain pipes to one pit. The extent to which this could be done would be governed by the comparison between the cost of laying the drain pipes and the construction of another pit. These pits could be periodically inspected by the outdoor staff, and water pumped out when necessary, thus entailing no extra working expense, and (which is of far greater advantage) without the risk of sewer gas and backwater entering the conduits and pipes, which would exist if they were connected to the sewers.

The next question is ventilating, and this I would deal with as I suggested in my last letter, by constructing the

ventilating boxes at proper places. I need add nothing more to that, excepting that where possible, and in suitable places, I would combine the ventilator with the catch-pit. There would still have to be both the ventilating pipe and the drain pipe, and the only saving would be that the pit and cover would be combined. This, however, would not be possible or advisable in all cases.

From the foregoing I think it will be seen that it is not at all necessary to abandon entirely all the mains now in use, and adopt Mr. Gilbert's "system" and "ideas," about which I should like to say a little; but I forbear, as his practical experience of the subject he is dealing with is evidently of a very limited kind.

B. H. Jenkinson, A.M.Inst.E.E.

Local Action in Accumulators.

This no doubt offers an interesting field for scientific investigation, which it is to be hoped will lead to practical results.

I think I am justified in asserting that in a well constructed accumulator the local action should be so minimised as to be rendered innocuous for practical purposes. That such a result has been obtained by me was proved by the tests which you kindly undertook some time ago, and the result of which is embodied in your report dated June 24th, 1893, of which I enclose a copy. These tests showed that cells which you received ready charged on June 16th, 1892, and which remained at rest until September 7th, gave at their first discharge an output of about 80 per cent. of the normal, thus proving that the total loss during about three months' rest only amounted to 20 per cent. This result is all the more favourable, as no special care was taken to insulate these accumulators whilst at rest, so that presumably the greater part of the loss may be accounted for by outside leakage.

In the interest of science I should like to know whether any other accumulator can show equally favourable results.

L. Epstein,
Managing Director, The Epstein Electric Accumulator Company, Limited.

January 28th, 1895.

Electric Light Photography.

Referring to the note on "Electric Light Photography" on page 77 of the REVIEW of last week, I agree that, at first sight, it seems unreasonable that the incandescent lamp should be used in photography in preference to the arc lamp, seeing that the light of the arc lamp is richer in those rays which are most potent in producing photographic effect. This being so, the more credit is due to Mr. Adamson for having shown, as he has done, the great value of the incandescent lamp for photographic purposes. Mr. Adamson has demonstrated that such a series of incandescent lamps as that described in your note is powerful enough to enable a photographic portrait to be taken in a single second, and that 6,000 such successive exposures still leave the lamps with a good deal more life in them, so that the rapidity of the action of such a series of lamps is quite sufficient to answer every ordinary requirement, and the durability and therefore economy of the lamp is also sufficient for all practical purposes. There are some not unimportant advantages very apt to be overlooked in this use of the incandescent lamp, and which, in some cases, more especially in taking portraits by artificial light, far more than outweigh the disadvantages of a less highly actinic light and a more complicated electrical apparatus. It is well known how great a tendency there is in ordinary photographic portraiture by daylight to a misrepresentation of the values of certain colours—blues being misrepresented by too strong an effect, and yellow and red by an effect too weak. This kind of error is exaggerated when the source of illumination is the electric arc, and one of the consequences in taking portraits by that light is, that the ruddy glow of health on the cheek is translated into a cadaverous hollow, and every freckle or minute redness becomes a conspicuous blotch, pitting the face as if by small pox. The light from incandescent lamps, when arranged in the way Mr. Adamson arranges it, although much less rich in violet and ultra-violet rays, than the light of the arc, is still energetic enough to make the required impression on the photographic plate in the camera in a single second, and from the smaller proportion of the highly refrangible rays, it results that the colour misrepresentation which is so marked a characteristic of photographs of coloured objects taken by the arc light, and even by daylight, is to a considerable extent rectified.

A secondary, but appreciable, advantage attaches to the use of incandescent lamps for photographic portraiture through the instantaneity with which a full and constant measure of light is obtained, whereas, as is well known, the arc requires several minutes before it becomes even approximately constant. The arrangement of incandescent lamps used by Mr. Adamson may perhaps be, in one sense, more complicated than an arc lamp, yet, when once the arrangement has been made, it involves far less trouble to keep it in order, and enables any required illumination to be obtained with far greater ease.

J. W. Swan.
(*Per* M. E. S.)

CORRESPONDENCE.—We have received a letter from Mr. R. R. Tatlock on the "Heating Power of Smoke," but owing to its late arrival and pressure upon our space, we are compelled to hold it over until next week.—EDS. ELEC. REV.

NOTES.

Personal.—Mr. E. O. Walker, C.I.E., formerly of the Indian Government Telegraph Department, has been appointed to succeed Mr. Simpson as superintendent of telegraphs and electrician in the Island of Ceylon. Mr. Walker has our cordial good wishes in his new appointment.

Insurance Companies and Jerry Wiring.—In the *Policy Holder* a discussion is proceeding regarding the rules of insurance companies with respect to electric lighting and the inspections made by their officials of buildings so lighted. The correspondence is very interesting, as it refers to questions which have been, and still are, under consideration in the technical press and among electrical men generally. One writer, speaking of the manner in which work is now being carried out by wiring contractors, says that he fully believes that when the present imperfect installations have had time to deteriorate slightly, numerous fires will result, and insurance companies will then awaken to the necessity of rigorous inspection by competent officials. He remarks that he could fill columns with instances of bad work carried out even by well known electrical firms, and he quotes one case where contractors erected incandescent lamps on gas fittings by merely lashing the wires to gas tubes. Another correspondent, speaking in the same strain, comments very sensibly upon what is really the cause of this jerry wiring. Being an inspector of 14 years' experience in electrical work, he is not a stranger to his subject when he remarks that it is notorious that prices for electrical installation work are becoming so undercut by reckless competition from unprincipled and incompetent contractors, that the many respectable contractors who really wish to conform reasonably to fire office requirements, are unable in a great many cases to obtain prices which will admit of their doing so. "Therefore, the best interests of the fire offices are undoubtedly being seriously jeopardised, now that electric lighting is becoming more general, and that so much of it is being carried out at prices at which it is commercially impracticable to put up good and lasting work. So much bad work is being done that it is highly probable the Fire Offices' Committee will, before long, have quite sufficient electrical fire loss statistics on hand to enable them to decide that the time for authoritative action on their part has arrived." All things considered, it seems that insurance companies with strict rules and stringent official inspections will be likely to do more towards extinguishing the jerry wireman and his malpractices than the attempts of any other body. Of course, to have these inspections properly conducted they will need to materially increase their staffs and their efficiency, and there should be concerted action on the part of the companies.

American Institute of Electrical Engineers.—On January 16th a paper was presented by Prof. Alexander Macfarlane, of Ithaca, N.Y., "On the Units of Light and Radiation," also one by Mr. Alton D. Adams, of Boston, entitled, "The Best Metal for Field Magnet Frames." A meeting of Western members was held the same evening at Armour Institute, Thirty-third Street and Armour Avenue, Chicago, where, in addition to the above papers, Prof. Stine presented an illustrated historical sketch of the first three-wire Edison plant at Sunbury, Pa.

Royal School of Mines.—The 22nd annual dinner of the old students of the Royal School of Mines took place last Friday evening at the Criterion Restaurant. Replying to a toast of "The Mining and Metallurgical Industries," Prof. Roberts-Austen said that they were told that the age of steam was giving way to the age of electricity, and, as regarded the metallurgical industries, that was no doubt as true as it was in the case of other industries. He saw nothing to regret in that. The modern dynamo was the direct outcome of the work of Faraday, and Englishmen had taken a leading part in the construction of the great installation which was to make the Niagara Falls available as a source of power on the other side of the Atlantic.

Incandescent Gas Mantles.—The Incandescent Gas Light Company, Limited, are scattering broadcast to their agents printed forms for the collection of particulars regarding certain people who are defrauding them by selling burners closely imitating those of this company, but actually made by other and unauthorised persons. These burners are fitted with mantles of the Incandescent Gas Light Company's own manufacture, which, the circular states, have been improperly procured. The object of the circular is to get together names of some of the people who are selling, and also those who are using this combination of burner and mantle. The agents are instructed to report to the company upon the pecuniary position and standing of such sellers and users. It appears to be the company's intention to issue writs against all who are "dishonestly trafficking" in the mantles.

The Pacific Cable.—A Reuter's telegram, which appeared in the *Times* of last Friday, announces that the Foreign Relations Committee of the United States Senate has unanimously decided to present an adverse report on the subject of permitting the landing of the proposed Pacific cable from Canada at Hawaii.

A telegram from Ottawa says that the preliminary negotiations in connection with the proposed Pacific cable have made great progress during the last few weeks. The Canadian Government recently asked the views of the Australian Governments on the question of State ownership, and at the same time forwarded a revised offer on the part of the lowest tenderer to construct the line, comprising greater speed and a transmitting capacity of either 15 or 18 words a minute. With this change the cost was found to be much less than the estimate furnished at the Colonial Conference last year. No objection was raised by the tenderer to construct and maintain a cable *viâ* Fanning Island.

Electricity in Agriculture.—Under the direction of the Imperial and Royal Agricultural Society an international mart or exhibition of agricultural machines is to be held at Vienna, from May 4th to 7th. The prospectus includes appliances used in all branches of industry connected with agriculture, such as the brewery, forestry, milling and breeding trades. The exhibition will comprise electrical machines used in the service of these industries. Possibly, as a result of this exhibition, we may have some tabulated information showing just where electricity stands in regard to agricultural operations. So far, not a great deal has been done, and if those interested take the matter up with enthusiasm, and get together a collection of up-to-date implements, it may lead to important developments, and the general adoption of electricity in farming and agricultural work which cover such an extensive field. We would like to suggest the setting apart of a special department for electrical apparatus. The Austro-Hungarian Consul-General will be pleased to give further details to anyone applying to him at 11, Queen Victoria Street, E.C., between the hours of 11 and 2 o'clock.

The Electrolysis of Nitro-Sulphuric Acid.—This has recently been effected in a solution of sulphuric acid by A. Gurcman (*vide Zeit. Anorg. Chem.*, 1894, vii., p. 161). The apparatus employed in the electrolysis was so arranged that the electrodes were separated by a narrow tube, in order that diffusion may be prevented as much as possible. A current of 4 volts and 0·1 ampère was employed. The positive ions of the acid, namely, NO and H_2, are liberated at the negative pole. The negative ion, SO_4, wanders to the positive pole, and is there split up into O and SO_3; the latter then re-forms sulphuric acid.

Death from Electric Shock.—There are accounts from Demerara of the first fatal accident there. We give the following extract from a letter of the engineer, Mr. Arthur H. Shaw, communicated to the *Electrical World*:—"An ordinary 16-C.P. 52-volt lamp was suspended in the stable of a house, and upon a black man going to turn it on he received a shock, from which he did not recover. He was in his bare feet at the time, and the ground was damp. The house circuit was a 52-volt alternating secondary, with 1,040 primary. All the lamps continued to burn as usual after the accident, and no fuses were blown. On testing the transformer the next day, I found a slight leakage between the primary and secondary, the insulation having no doubt broken down completely when the current was on. The insulation of the feeders and mains was the same as usual the afternoon of the accident, and also the next morning, there being no extra ground on. On testing the house circuit the next day I found a slight ground on the stable circuit, but this should have been in favour of reducing the shock that the man got off the same circuit."

Electric Traction by Tommasi Accumulators.—The appearance of an electric cab, which has been working in Paris for some days, is somewhat similar to that of the petroleum cab. A battery of accumulators in a case is placed behind the seat, and a small motor is under the cab; a guiding apparatus for both hands, a powerful brake to be worked by the foot, a brake which is connected with the distributing circuit-breaker, and that is all. The accumulators used are of Dr. D. Tommasi's type, which are distinguished from other oxide of lead accumulators by a special mode of construction. Each electrode consists of a casing of celluloid, perforated with a number of little holes, and filled with active material, in the centre of which is placed a leaden frame serving solely as conductor for the current, and not as a support for the active material, as in all other systems of accumulators. The electrodes of the same nature are soldered together to a connecting base, and separated from the next by vertical rings of celluloid. The case is of wood, lined inside with celluloid, and closed at the top by a lid absolutely air-tight and transparent. The accumulator thus constituted is of small bulk and comparatively light weight; its capacity is about 25 ampère-hours per kilogramme of electrodes. It is said to be quite unaffected by shocks and vibrations, and sustains without injury extremely high rates of discharge. The battery which drives the motor of the cab consists of 21 accumulators, each weighing 13 kg. 300 gr., and enclosed in seven boxes, each containing three elements. These elements, which are connected in series, give on an average 100 ampères at 40 volts. For startings, and for steep inclines, the current rises to 200 ampères. Under these conditions, the battery works for an hour and a half, corresponding to a capacity of 7·5 ampère-hours per kilogramme for a low output, 11 ampère-hours per kilogramme for an average output, and 15 ampère-hours per kilogramme for the maximum output. With more moderate rates the capacity would be much higher, *i.e.*, 22 ampère-hours at a rate of 1 ampère per kilogramme, 18 ampère-hours at a rate of 3 ampères per kilogramme, and 15 ampère-hours at a rate of 6 ampères per kilogramme. The total weight of the cab, with two passengers, is about 1,200 kg., and its speed is 20 kilometres an hour. It can very readily be started. Stoppages can be as instantaneous as required. The movement of the electric cab is absolutely silent, and its guidance is extremely easy. An interrupter enables the battery to be completely insulated from the motor in the case of a prolonged stoppage.

Manchester Association of Engineers.—On Saturday last, before this Society, two papers were read on "Electricity as the Future Motive Power in the Textile Industries," by Mr. G. H. Firth and Mr. D. Selby Bigge.

The Institution of Electrical Engineers.—At a students' meeting, to be held in the Institution Library on Friday, February 8th, at 8 p.m., a paper will be read by Charles E. S. Phillips on "The Magnetic Condition of Matter," illustrated by experiments.

London County Council and Overhead Tramways.—The Council have adopted the recommendation of the Highway Committee not to sanction the use of overhead wires as a means of working the West Metropolitan Tramways. This was agreed to after some discussion, during which an amendment was moved by Mr. Beachcroft to allow the company to make the experiment. We refer to this decision of the County Council in another note.

Glasgow Telephones.—It will be remembered that not so very long ago, when the Town Council went into the question of purchasing the telephones, their attitude was somewhat favourable towards such a scheme. At the present day, however, they are no nearer accomplishing such a purpose than they have ever been. The latest decision at which they have arrived is to co-operate with the Corporation of Glasgow in pressing upon the Postmaster-General the advisability and the necessity for the Government taking over the telephone system as they did the telegraph 25 years ago, and to ask him to receive a deputation from them on the subject.

Obituary.—Carl Thomas Blanch-Brain.—We regret to record the death of Mr. Brain, electrical engineer, of Helsby, who committed suicide at the London and North Western Hotel, Liverpool, last Friday night, or Saturday morning. Evidence showed that the deceased had overstudied a good deal of late. Mr. Brain was, perhaps, best known as the inventor of a closed conduit system for electric traction, a description of which appeared in the ELECTRICAL REVIEW some time ago. There was a good deal of merit in the system, and Mr. Brain had very ingeniously worked out the details. Mr. Brain was 29 years of age, and was married.

We regret to hear of the death of Mr. Thomas Barnett Grant, of Messrs. Bourne & Grant, the cause being typhoid fever.

We also regret to learn of the death of Mr. Thomas Bird, manager of the General Electrolytic Company's works at Farnworth.

Working Ship's Turrets by Electricity.—If the Admiralty were dominated by the best procurable men who officer our "first line of defence," instead of by mere politicians whose party happen for the nonce to be in power, it is possible there would be less of that tardiness now so evident in adopting new ideas. That this country should actually be behind such countries as Chili, Spain, and Denmark, not to mention the great European naval powers or the United States, is simply preposterous. Yet the fact remains that it is. In the French Navy the substitution of electrical for hydraulic power on board a man-of-war has ceased to be problematical, and has passed out of the experimental phase into that of actual adoption on a large scale. The progress which they are making in the United States in this direction has been commented upon in these pages many times. And now we learn that the Spanish Government has definitely decided to abandon the hydraulic worked turrets which were fitted upon the three new cruisers built in England a short time ago, and have accepted the system of working by electricity for some other ships—the *Carlos V.* amongst them—as offering many and great advantages. The latest addition to the Danish Navy, the *Skyold*, has her turrets worked by electricity, and so has the *Capitan Prat*, recently added to the Chilian Navy. It has been pointed out in the able articles appearing, by Mr. Spencer Wilkinson, in the *Pall Mall Gazette*, that the navy of this country is not properly equipped either in guns, *personnel*, armament, or engine capacity; under such circumstances it could hardly be otherwise than expected that we should be behind other nations, not relatively but actually, in regard to the adoption of electrical power on board our men-of-war.

Fatal Accident at Bordeaux.—Telegrams dated 25th January, from Bordeaux, state that a workman engaged repairing a telegraph wire, allowed one end of the piece he was holding to fall on the electric railway cable below. As his hands were bare at the time, the current entered his body, and he was instantly killed.

Lectures.—Prof. J. A. Fleming delivered a lecture at Ashford, on 21st ult., his subject being "Magnets and Electric Currents."

Before the Edinburgh Association of Science and Art last week, Mr. Matthew Buchan, of the Edison and Thomson-Houston Electric Company, Boston, U.S.A., read a paper on "Electrical Engineering."

The Telephones and the Government.—Mr. Arnold Morley on Thursday, last week, received a deputation from the Association of Municipal Corporations in regard to the agreement between the Post Office and the telephone companies for carrying on the telephone system of the country. In replying, Mr. Morley acknowledged that the telephones might be more satisfactorily worked by the Post Office than under the companies, but stated that, with the experience of the purchase of the telegraphs, the Government were not prepared to enter into the question of the compulsory purchase of the telephone system from the companies.

Exhibition at Bordeaux.—The thirteenth exhibition at Bordeaux will be held during the present year. The ninth section will be devoted to electrical science, under the presidency of M. Durègne, Engineer-Inspector of the Telephone Service. There will be eight classes of exhibits, devoted, respectively, to "Educational Electricity and Magnetism," "The Industrial Production of Electrical Energy," "Electric Lighting," "The Transmission of Electrical Energy," "Electro-Metallurgy and Electro-Chemistry," "Telegraphy, Telephony, and Signalling," "Medical Electricity," "Various Applications." The secretaries to the Commission are MM. A. Marton and G. Vène.

Electric Railways in England.—The improvement of the City and South London Railway Company, from a financial point of view, will be seen from a perusal of the directors' report in our "City Notes" columns, and it is also evidenced by the price at which the ordinary stock is now selling on the Stock Exchange, as compared with former quotations. Similar and even greater prosperity is being enjoyed by the Liverpool Overhead Railway Company. Those who take an interest in our "Traffic Receipts" will have observed that every week lately on this line there have been increases of £200 to £300, as compared with the corresponding weeks in the previous year. Of course several extensions carried out during the year 1894 have to be taken into account, and these are doubtless responsible in a large degree for the increased traffic. The securities of the Liverpool Company have nearly doubled in value upon the Liverpool Stock Exchange within the past 12 months.

Amsterdam Exhibition, 1895.—For the management of the World's Exhibition of Hotel Equipment and Travel, which is to be opened in Amsterdam on May 1st, a large and influential committee has been formed, with Sir Albert Rollit, LL.D., M.P., &c., as president. Forms of application for space, and prospectuses, may be obtained from Reuter's Agency, at 25, Old Jewry, E.C. In the classification of exhibits into groups, the following entries are made of machinery and apparatus connected with the electrical industry. Group II.—Means of transport. By land: Electric, steam, and horse tramways. By water: Models and drawings of ships with electric power. Group VII.—Machinery. Class A, machinery to produce electricity for motion and lighting; Class G, electric bells, fire signals, telephones, telegraphs. Group VIII.—Lighting. Class A, by electricity. Class E, lighting of bed-rooms, dining-rooms, offices, &c. Class F, lighting of drawing-rooms, halls, staircases, and large rooms. Class G, lighting of ships, railway carriages, and other travelling conveyances. Class H, apparatus for illuminating in the open air. Class I, various apparatus for lighting. Group X.—Various means of heating.

Terrestrial Magnetism.—Before the Royal Geographical Society Prof. A. W. Rücker, F.R.S., read a paper on this subject on 22nd ult.

The Wolverhampton Electricity Works.—Lord Kelvin formally opened the Corporation Electricity Works on Wednesday last.

New Swindon Junior Engineering Society.—Before this society, last Saturday, a paper, on "The Distribution of Electrical Energy," was read by Mr. Douglas T. Heap, A.I.C.E., M.I.M.E.

The Institution of Junior Engineers.—The members of this Institution held their tenth anniversary dinner at the Westminster Palace Hotel, last Saturday evening, Mr. Alexander Siemens (President) occupying the chair. The toast list was rather formidable, but the racy and humorous speeches of Profs. Ayrton and Ewing, and the somewhat ponderous utterances of Prof. George Forbes, who now changes all his ideas, rules, and principles of engineering about every six months, so as to run in an English groove when here and in an American rut in the States, were quite to the taste of the members, as were the president's little stories. But we refer our readers to the "yellow book" for an illustrated report of the proceedings. The society, which was initiated by the meeting of some half-dozen young fellows desirous of self-improvement, now numbers over 400 members, and we congratulate both Mr. Wells and Mr. Dunn, who have laboured so earnestly and successfully in the cause of the junior engineers, on the very encouraging and gratifying results of their unselfish work. That the Institution is doing valuable service, and that the future standard of youthful aspirants to engineering will be raised through its means, we have no doubt, and we cordially wish the Institution a succession of good presidents and increasing prosperity.

Communication with Australasia.—In our last issue we called attention to the two recent instances in which communication with Australasia has been completely broken down, the first case being that on December 18th last; in the second case the interruption, as far as one can gather from published telegrams, occurred on January 18th or 19th, and lasted until the evening of January 25th, when telegrams dated the 19th were published in London; and when we learn from an evening contemporary that a telegram sent by their special correspondent in Adelaide had been delayed in transmission, "owing to the breakdown of the wires at Port Darwin." As no mention is made of the Western Australian landline or of the "alternative" cable which was laid from Java to Roebuck Bay to assure communication in case of a breakdown of the Java-Port Darwin route, we can only conclude that probably for reasons given in our article above referred to, this route was as useless as the Hon. Thomas Playford's remarks would lead us to expect it would be. In view of the necessities of the case, it might be possible, by erecting a landline from Port Darwin to Burketown in Queensland to join the Queensland system of landlines, and thus to a certain extent to diminish the inconvenience of which we complain. In relation to the interruptions which we mention above, we would refer our readers to the recently issued *Journal Télégraphique* of January 25th. This is the official publication of the Bureau International des Administrations Télégraphiques, in which is given a detailed list of interruptions and repairs to the various telegraph lines. We find, however, no reference to the total isolation of Australasia, to which we now draw the attention of our readers. From this we gather that the Administrations concerned have not kept the Berne Bureau properly informed in accordance with the International Telegraph Convention (Chapter lxxxii., article 4), which we reprint here:—"In addition to this, the said Administrations send to that office, by telegraph, notices of all interruptions and restorations of communication affecting international traffic." We understand that the proposals made in connection with the Pacific cable scheme have been forwarded to the various Australian Governments by the Canadian Government, and we have no doubt that the unsatisfactory state of the "existing" lines will once again serve to accentuate the necessity of the Pacific cable, which will furnish a real alternative to the present intermittent system.

Cable Repairs.—The ss. *Dacia*, belonging to the Silvertown Telegraph Company, left Cadiz last Saturday to effect the repair of the cable which connects the Canary Islands with Spain. We learn, just as we go to press, that the Gibraltar-Tangier cable was repaired on Wednesday.

Medical Electrical Institute.—On Tuesday afternoon Mr. Geo. Henderson, on the part of Mr. Furber, a debenture holder, asked Mr. Justice Kekewich *ex parte* to appoint over Friday, February 1st, a receiver and manager of the Medical Electrical Institute, Limited, and his Lordship granted the application.

The Telegraph Commemoration Dinner.—On Monday night, in the Whitehall Rooms of the Hôtel Métropole, a distinguished company of politicians, post-office officials and cable men assembled at a banquet in commemoration of the 25th anniversary of the taking over by the Government of the country's telegraphic system.

The Cantor Lectures.—Before the Society of Arts, on January 28th, Prof. Silvanus P. Thompson, F.R.S., delivered the third and last of his Cantor lectures on the arc lamp. The first part of the lecture was occupied with the further consideration of some points in the physics of the arc, which had been touched upon in earlier lectures. It was mentioned that, if the arc is produced inside a glass globe to which the atmosphere has not free access, the total consumption of carbon is much lessened with a given current; a brown deposit, however, takes place on the glass, and this, after the lamp has been burning for some time, cuts off a large proportion of the light. Prof. Thompson also discussed some of the causes which produce irregularity in feeding; among these are certain impurities in the carbon employed, using a lamp with a higher voltage than that for which it is designed, and using carbons which are damp. The rest of the lecture was taken up with a consideration of the various mechanical devices used in arc lamps to keep the carbons in their proper positions. Photographs of a large number of lamps were thrown on the screen, particularly with a view of showing what directions improvements have taken during the last six years. Although, he said, a large measure of success has been attained, the universal lamp, to work equally well with continuous or alternate currents has not yet been devised.

More Explosions.—We regret having to record more explosions in electric light main boxes; this time they have occurred at Rochester, Eastbourne, Newcastle and Dover. Shortly, the facts are as follows:—Early on Friday evening, January 25th, an explosion occurred in a transformer pit in front of the Guildhall, High Street, Rochester, and sent flying in the air a number of flagstones and the two pit covers, and brought down the brickwork lining of the pit. The police smelt a very unpleasant odour. The electric light company are preparing a plan of the transformer pit where the explosion occurred, for the information of the Board of Trade. Major Cardew made an inspection on behalf of the Board of Trade on Wednesday at Rochester. The explosion at Eastbourne also occurred on the same afternoon. From what we learn, it seems that one of the Eastbourne Company's electricians was engaged testing a piece of cable between two road boxes. He was using a spirit lamp at the latter box for the purpose of drying the cable ends before testing, when the explosion occurred, blowing up the cover of one box, and displacing two others. With the report a black smoke issued from the first mentioned box for a few seconds, and there was a strong smell of gas. To this the explosion is attributed, as the engines of the Electric Light Company were not running at the time, and their mains were not charged. One old lady from the Workhouse, aged 66, was thrown down by the shock. Another explosion occurred at Newcastle on Saturday, but this does not appear to have any connection with the electric light mains. A man was attending to the underground telephone wires in Grey Street, and as the metal box-lid was frozen, a flame was applied. A violent explosion followed, and the man was thrown to the ground. It is supposed there was an accumulation of gas in the box. The electric light mains are not blamed for this explosion, for we believe they are not yet laid down in Grey Street, though they are shortly to be.

Last night's papers state that an explosion took place in an electric light street box at Dover yesterday morning.

The Æsthetes of the Metropolis.—We all know the powers of the County Council for good and for evil—mostly for evil—but we think they did injustice to their progressive tenets when they prevented electric traction by overhead wires at Shepherd's Bush. They have attacked a good many things in their time, they have assailed the Empire on moral grounds, they have made an onslaught on transformer boxes on grounds best known to themselves, they do not want overhead wires, and they tried to make difficulties in the way of putting them underground. The beauties of London are not very apparent until you begin to talk about putting up overhead wires, then the sole arbiter of our modern Rome, the County Council, protests with strange vehemence against destroying the artistic merit of the streets. We are not going to say that the County Council ventures out of its depths when it begins to discuss artistic matters, but we will say that we are about tired of pointing out that tramways in London do not traverse a single decent thoroughfare. Messrs. Benn, M.P., and John Burns, M.P., bursting with their cheap American experiences, gave us some unmitigated drivel about depriving the people of the blue sky, and the hideous network of wires. We are surprised, not to say grieved, however, to find the *Pall Mall Gazette* approving of the action of the London County Council. Either the wrong man has written the *Pall Mall* note, or the Electrical Review is not read as closely at the *Pall Mall* office as we thought. To speak of "gigantic pillars" for overhead wires shows ignorance, and to say that a system of steam trams is a sightly method of locomotion savours of imbecility. There are worse things in the streets of London than electric tramways; certainly it is no treat to see the poor knots of humanity who flaunt yellow *Pall Mall* posters.

NEW COMPANIES REGISTERED.

Electrical Oil Refining Company, Limited (43,126).—This company was registered on January 26th with a capital of £5,000, in £1 shares, to acquire a patent relating to the bleaching, refining, sweetening, and purifying of oils and fats by means of electricity or otherwise, and obtaining colouring matter therefrom, and with a view thereto to adopt an agreement. The subscribers (with one share each) are:—G. H. Wise, Hume Street, Hull, oil refiner; R. W. Hoar, Wellington Road, Snaresbrook, manager; L. W. Shepherd, 11, Queen Victoria Street, E.C., solicitor; R. Fosster, 11, Queen Victoria Street, E.C., clerk; H. W. Bradley, 5, Gray's Inn Square, clerk; H. N. Paisley, New Barnet, Herts, solicitor; W. W. Bradley, 5, Gray's Inn Square, clerk. Registered without articles of association by Seaton F. Taylor, 5, Gray's Inn Square, E.C.

Tramways Electrical Traction Company, Limited (43,132).—This company was registered on January 28th, with a capital of £172,500 in 15,000 shares of £10 each and £15,000 of £1 10s. each, to adopt an agreement with the Tramways Company of France, Limited, to construct, lease, or otherwise acquire, tramways, light railways, electrical plant, &c., and to carry on the business of carriers of goods and passengers, omnibus and van proprietors. The subscribers are:—R. H. Browne, Leith Villa, Reigate, director, 50 preference shares; J. B. Concanon, 28, Austin Friars, stockbroker, 100 preference shares; H. Rutin, 6A, Austin Friars, E.C., stockbroker, 100 preference shares; W. G. Woolston, 6A, Austin Friars, E.C., 100 preference shares; J. Walker, Stock Exchange, gentleman, 4 preference shares; J. Lazarus, 52, Threadneedle Street, bank manager, 50 preference shares; J. B. Glenn, 7, Poultry, secretary, 50 preference shares. There shall not be less than three nor more than seven directors, the first being—Lord R. H. Browne, C. Burrell, J. B. Concanon, W. Holdinstein, and E. Lazarus. Qualification £250; remuneration £1,000 a year, divisible. Registered by Ashurst, Morris, Crisp and Co., 17, Throgmorton Avenue.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Brighton and Hove Electric Light Company, Limited.—The statutory return of this company, made up to December 31st, 1894, was filed on January 15th. The nominal capital is £100,000, in 20,000 shares of £5 each, and of these 3,001 shares have been taken up. Upon each of these the full amount has been called or paid, or they have been issued as fully paid. The company is now in the hands of a receiver and manager.

British Electric Tramways and General Syndicate, Limited.—The statutory return of this company, made up to July 28th, 1893, has been filed. The nominal capital is £10,000, in 1,850 "A" shares of £5 each, and 150 founders' shares of like amount. Of these, seven "A" and 87 founders' shares have been taken up. On the seven "A" shares nothing has been paid; but on the founders' shares the full amount has been called up, the total amount of calls received being £435.

Column Printing Telegraph Syndicate, Limited.—This company's statutory return, made up to August 24th, 1894, has been filed. The nominal capital is £25,000, in 500 shares of £50 each, and of these 249 have been allotted, and £50 called upon them. The total amount of calls received is £6,800, while 100 shares have been issued as fully-paid, and calls to the amount of £650 remain unpaid.

Llanelly Electric Light and Power Company, Limited.—The statutory return of this company, made up to November 10th, 1892, was filed on November 21st, 1894. At that date, out of a nominal capital of £15,000, divided into 10 "A" and 14,990 "B" shares of £1 each, only the seven "A" shares taken by the signatories had been subscribed, and nothing had been called upon them.

Maudslay, Sons & Field, Limited.—The statutory return of this company, made up to July 13th, 1894, has been filed, and shows that the capital is £350,000, in 25,000 ordinary and 10,000 6 per cent. preference shares, all of £10 each. The whole of the capital has been subscribed, the total amount received by the company being £100,000, while shares to the amount of £250,000 have been issued as fully paid.

Queen Anne's Mansions Lighting and Heating Company, Limited.—The annual return of this company, made up to January 11th, was filed on January 23rd. It shows that the nominal capital is £60,000, divided into 3,000 preference and 3,000 ordinary shares of £10 each, the whole of which have been issued as fully paid. No cash appears to have been received by the company.

Railway Automatic Electric Light Syndicate, Limited.—The statutory return of this company, made up to December 31st, 1894, was filed on January 15th. The nominal capital is £25,000, divided into 400 ordinary and 600 preference shares of £25 each. The number of shares taken up is 396 ordinary and 600 preference. On 200 ordinary and 550 preference the full amount of £25 has been called up, but on 50 preference only £20 has been paid. The total amount received by the company is £18,103, while calls to the amount of £1,592 are unpaid, and four shares have been forfeited. 200 shares have been issued as fully paid.

Peru Telephone Company, Limited.—This company filed its statutory return, made up to January 14th, on January 25th. It shows that out of a nominal capital of £100,000, in £5 shares, only the seven signatories' shares have, so far, been taken up, and nothing has been called up on them.

THREE CENTRAL ELECTRIC LIGHT WORKS.

Municipal electric light works increase so rapidly that there is no keeping pace with them. All that we can hope to do, and this will be still more marked in the future, is to note the principal points and record the chief novelties of central station work. Even with this modest programme we must needs be fairly busy, for now that greater scope is allowed to engineers there is less tendency to slavishly follow existing designs. It is an important factor in many of the new works, particularly in those owned by municipalities, that there is a desire to improve on the work of other corporations. Providing this spirit of emulation is not carried to extreme lengths we are confident that much good will result. It is not, however, every corporation that is possessed with the craving to show something really good in central station work. Too often the works are starved at the outset for want of a little more outlay. We have also noticed among town councillors at times too great an anxiety to see a central station pay in the first few days of its existence, indeed, we know of one corporation station which has existed in a more or less complete form for little less than a month, where the mayor has been reduced to a state bordering upon insanity because the electric light works have not yet begun to show a return. The mayor happens to be a northcountry man, and, not being responsible for his nativity, must naturally feel some keenness about profits. We have no wish to aggravate the condition occasioned in this good man's mind by a non-paying load, but we should really like to say that if a profit is made in less than two years' time there will be no cause to grumble.

We should be sorry to see any undue anxiety displayed by town councillors as to the early profits of a central station, because they cannot really judge of the paying qualities of electric light works in less than two years, unless exceptional local conditions prevail.

The works that we have to bring before our readers this week are Halifax, Nottingham, and Dewsbury. Each is owned and controlled by municipal authorities. This is about the strongest point of similarity in the three works. It must not be understood, however, that we have brought them together with any desire of making comparisons.

THE HALIFAX WORKS.

The Corporation works comprise a system of high pressure alternating currents with sub-station and house transforming apparatus. The works do not present anything specially remarkable, unless we reckon an admirably designed and elegantly proportioned station. The sub-stations at the present moment are not numerous, only two being in working order. The district, which is supplied with a low tension three-wire system, is shown black on the outline map of the town given herewith. Many of the mains shown dotted, run to isolated house transformers, which as will be seen from the already mentioned map, are fairly numerous though somewhat scattered. In one respect, the Halifax works are noteworthy, they have been throughout designed and constructed by a resident engineer, a fact which is still worth recording.

In 1892, the town authorities secured an Electric Light Provisional Order, and shortly afterwards engaged the services of Mr. T. P. Wilmhurst, at that time chief engineer of the Exeter Electric Light Company. The system suggested by Mr. Wilmhurst was the one we have already recounted. Before proceeding in the matter, however, the Corporation took further advice, and this being confirmatory of the engineer's scheme, it was at once proceeded with.

The works are built on the site of an old mill, the space being ample for future extensions. The site is remarkably convenient, it being near to the Lancashire and Yorkshire Railway, from whence a siding will be run into the coal stores, directly over the boilers. Water is in abundance, a supply being derived from three wells on the property; in addition a stream flows past the station, the water of which can be utilised for condensing purposes.

The buildings are divided into dynamo room, boiler house, workshops, stores, test rooms, &c.

In the boiler-house are three high pressure cylindrical steam boilers, supplied by Messrs. Yates & Thom, they are each 30 feet long and 7 feet 6 inches diameter, with two internal flues 3 feet diameter, constructed from best mild Siemens-Martin steel plates, for a safe working pressure of 140 lbs. per square inch. The longitudinal seams in the shell are butt jointed, with double cover straps, and trebly riveted on each side of the joint, having six rows of rivets, the circular seams being double riveted. The flues are solid welded throughout in the longitudinal seams, and the transverse seams are formed with flanged joints of the strongest and most approved construction. The end plates are securely stayed with gusset and longitudinal stays. All the plate edges are planed and the rivet holes are drilled with the plates bent in the position they finally occupy, and riveted by hydraulic machinery. Cast steel mounting blocks to receive the boiler fittings are double riveted to shell. Each boiler is supplied with a complete set of high class modern fittings, including high steam and low water safety valves, and dead weight safety valves. The stop valves have bodies of cast steel.

Hand firing in electric light works may be said to have become almost obsolete, and Halifax is no exception to the all but general rule. Proctor's coking stokers are used; they have a special ramming arrangement, which, combined with moving fire bars, precipitates the burnt ashes into the ashpit. Hand firing can be substituted for the mechanical means without alteration or detriment to the automatic stokers. In connection with the coal feeding arrangements, it is interesting to consider the drawing of the end elevation of the stokers. It is obvious from this that shoots are led from the hoppers of the stokers to the floor level above, which is the coal store.

It is the intention to run coal trucks from the sidings direct into this store, the floor having been specially strengthened for the purpose. Such an arrangement must be distinctly a labour-saving one, and is a decided improvement on some methods adopted for getting coal to the boilers. While speaking on the subject nearly related to the fuel question, we ought not to omit to mention the fact that coke breeze is used during the hours of light load. We understand that the cost per ton is 3s. 6d., a price which, in a town remarkable for cheap coal, is somewhat high. It is not long ago that coke breeze and other low class fuels were to be obtained merely for the asking; but since electric light stations have, by means of artificial draught, shown the possibility of burning cheap fuel, the price has been enhanced considerably.

There is no distinct system of forced draught employed at Halifax, a steam jet is in use during the time coke breeze is burnt; but this, of course, cannot be expected to do much more than keep the bars clean.

The shafts of the stokers, as well as the scrapers of the Green's economiser, which is used, are driven by a small Marshall engine. At the present moment, as we have already said, three boilers have been fixed, though sufficient space is left to accommodate five more.

The main steam ring supplying steam from the boilers to the engines is of cast-iron. It is 10 inches in diameter, and 250 feet long; the exhaust pipe is about 100 feet long, and consists of 15-inch and 12-inch wrought and cast-iron pipes. The feed pipes from the pumps to the boilers are 3 inches diameter, they are of wrought-iron and 300 feet long.

The boiler feed pumps are of the vertical duplex type; they have 8-inch steam cylinders, 5-inch pump-cylinder, and a 7-inch stroke. The pump for dealing with the condensing water is of the compound type, having 6-inch high-pressure cylinders, 12-inch low-pressure cylinders, with 12-inch pumps, and a stroke of 12 inches. This pump will easily raise 30,000 gallons per hour.

The steam pipes, pumps, and accessories were supplied by Messrs. W. H. Bailey & Co., Limited.

We should mention that Hopkinson parallel slide valves are used on the main steam ring.

The Generating Room.

The interior of the generating room is one of the handsomest in the country. From an æsthetic point of view it is, perhaps, a little marred, though not over much, by the steam and exhaust pipes; we understand, however, that it was absolutely impossible to arrange them in any other way. Electric light works are not generally built to gratify the whims of wandering æsthetes, but it must be admitted that a good deal of taste has been exhibited in designing the interior

arrangements. The walls are lined with enamel bricks which are set off with a dado of amber bricks. The machinery is well laid out, yet roominess is a distinct characteristic. It will be seen from the general view of the works that the engines are placed about a foot higher than the electrical machinery. The engines for driving the alternators are of the horizontal compound type and are condensing. They cylinders are in all cases steam jacketed. The high pressure cylinders are provided with slide valves of a type much used by Pollit & Wigzell. It is practically a main distribution valve provided with a cut-off plate of circular form; the ports leading through the distribution valve are set diagonally on the circular cut-off face, the cut-off valve being made to a similar shape. The eccentrics give a sliding motion to

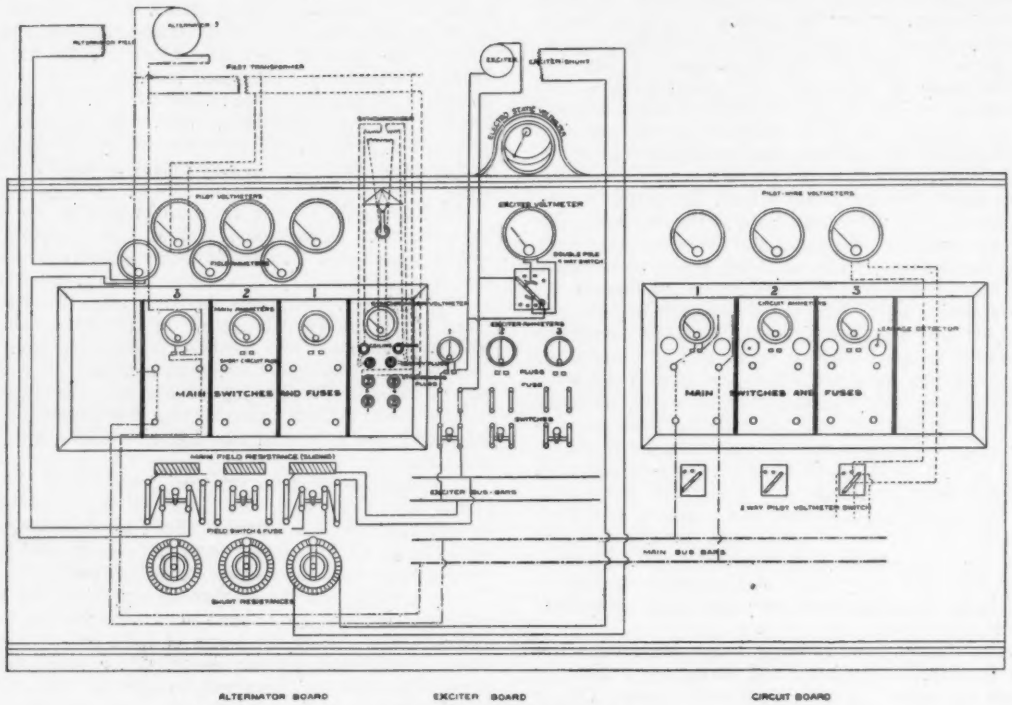
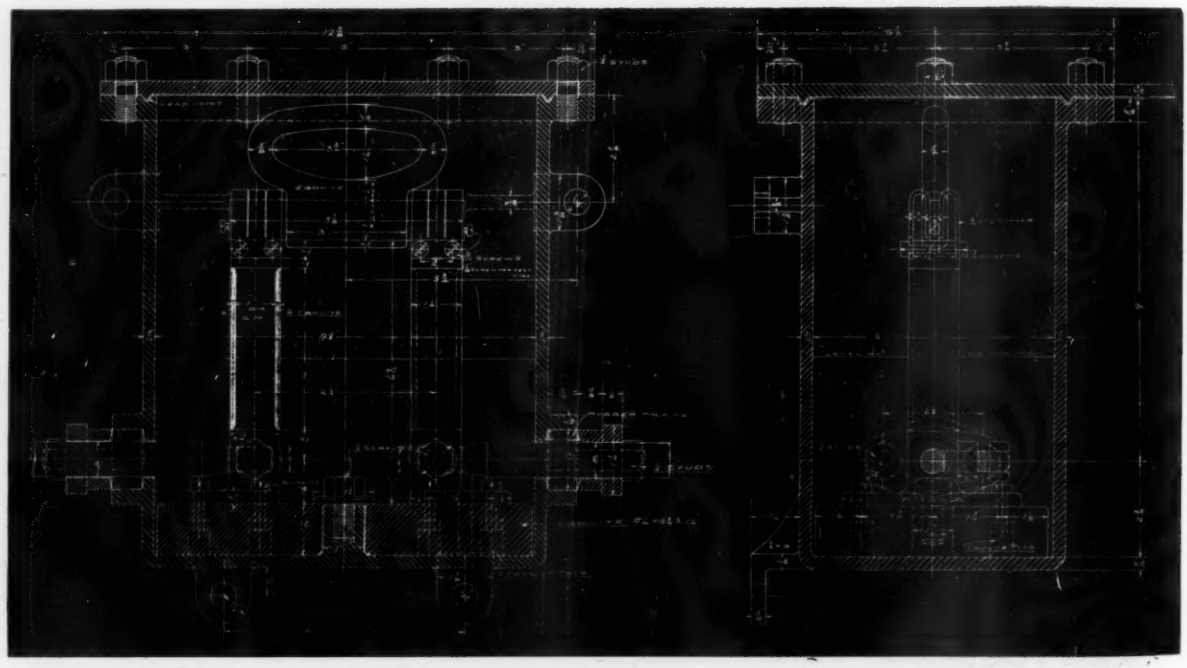


Diagram of Switchboard.

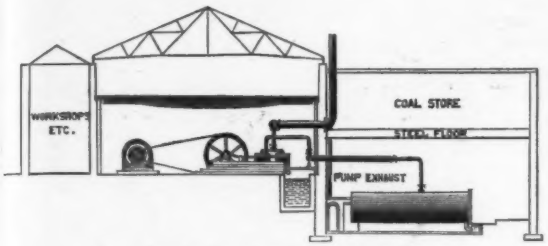


Disconnecting Box.

are fine specimens of this class of engine and by their adoption at Halifax a new firm has been introduced to electricity works, Messrs. Pollit & Wigzell, of Sowerby Bridge. There are three engines driving alternators by means of ropes. The two larger ones each develop 200 horse-power at 110 revolutions per minute. They work at a pressure of 140 lbs. The both valves; the governors being connected to the cut-off spindle, when varying the plane of revolution, cause the valve to rotate on its face, which thus regulates the steam admission according to the load. The low pressure valves are in many respects similar to the high pressure ones, they are, however, regulated by hand gear on the spindle. Pendulum lubrica-

tors are fitted on the crank pins, while an oil pump worked by a belt from the main shaft pours a continuous stream of oil on to the main bearings. The cylinders and steam chests are lubricated in a similar manner.

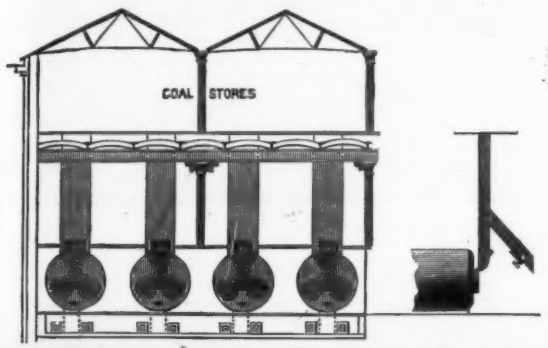
Piston rods are fitted with revolving stuffing boxes which are designed for the purpose of keeping the rods round and true.



Steam Exhaust Pipe Section.

The fly-wheels of these engines are 11 feet in diameter and are grooved for 10 1¼-inch ropes. The weight of the complete wheel is 11 tons.

A special type of air pump is used, it being one of Pollit and Wigzell's patents; it is of horizontal form and is worked from the low pressure piston. A neat arrangement of valve

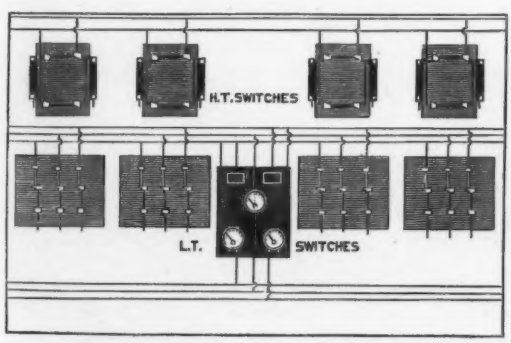


Mechanical Stokers connected by Shoots to Coal Store Above.

is employed on the exhaust pipe from the low pressure cylinder by which the exhaust steam can be turned either into the air or into the condenser. With the exception of smaller dimensions the third engine is in all respects similar to the larger ones, it indicates 100 horse-power. The engines stand upon an exceedingly solid foundation.

The Alternators.

Of the alternators which are driven by these engines, it is not necessary to detail much; suffice it to say they are



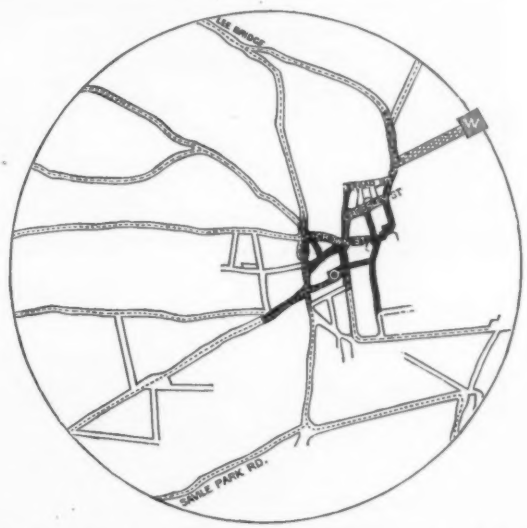
Elevation of Sub-station Switchboard.

of the Lowrie-Hall type and are constructed by the Electric Construction Company. The two larger ones have a capacity of 100 kilowatts, the smaller one having an output of 50 kilowatts at 520 revolutions per minute. The voltage of the machines is 2,000, and the periodicity 86 per second. The bearings are fitted with water jackets and automatic lubricating pumps. The machines are, of course, intended for parallel running.

The exciting current is obtained, in the case of the small alternator, from an exciter driven by ropes from the alternator shaft. In the case of the other two machines, two exciters driven by Robey engines, are employed. Each exciter is capable of exciting all the alternators; they are 12-unit machines, and give a pressure of 100 volts when running at a speed of 800 revolutions per minute.

The two small engines which drive two of the exciters, are made by Robey & Co. They are of the compound horizontal type, with overhung fly-wheel and outside bearing. The high pressure cylinder is 5½ inches, and the low pressure one 9 inches. They run at a speed of 160 revolutions per minute, and indicate 20 horse-power. The alternators are driven by four ¾-inch ropes. It may be mentioned that these engines have been designed to be able to run for long periods.

Before taking leave of the generating room, we ought to mention one or two interesting points concerning the structure. Underneath the floor runs a large trench lined with concrete, which communicates with the reservoirs. The injection pipes of the condensers dip into this trench; the waste water from the condensers then flows as we have already said through a 15 inch iron pipe to the entrance of the reservoir, then it passes round, and is cooled. At both ends



○ Sub-stations. Low-tension mains shown black; primary circuits shown dotted.

Map of Lighting Area.

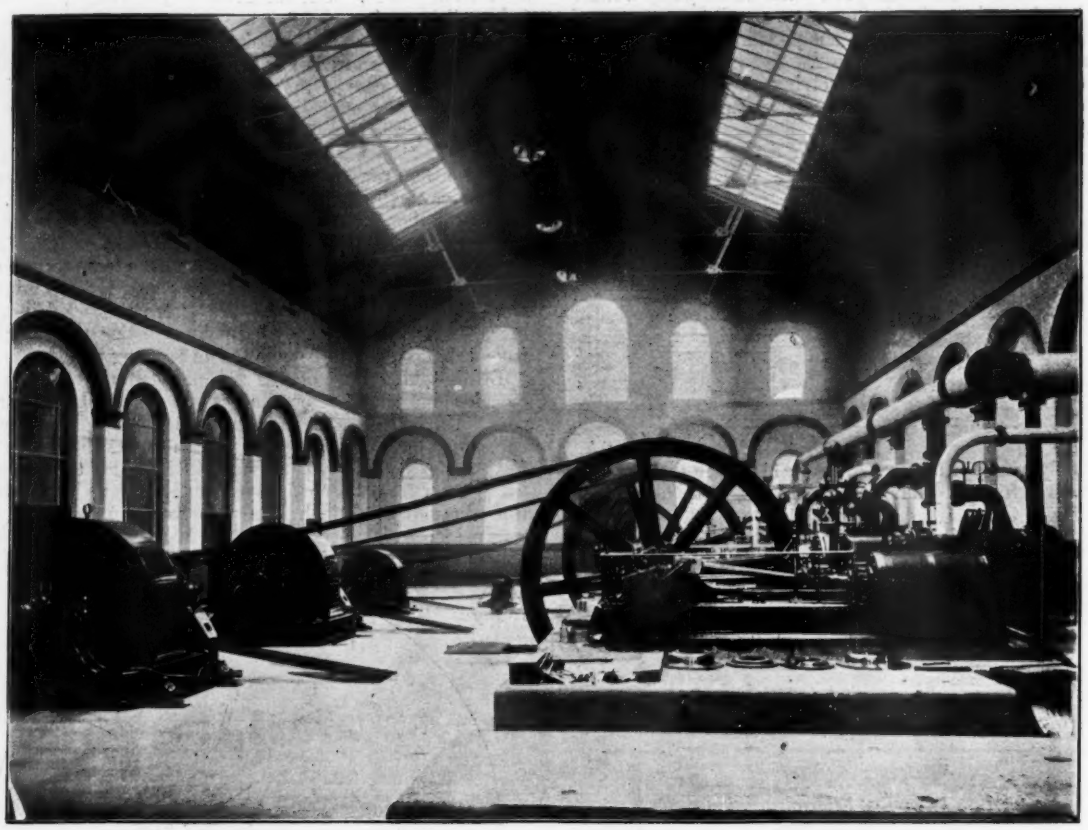
of the steam ring in the generating room are fixed MacDougall steam driers, the condensed steam being passed through Lancaster and Tonges steam traps.

The Switching Arrangements.

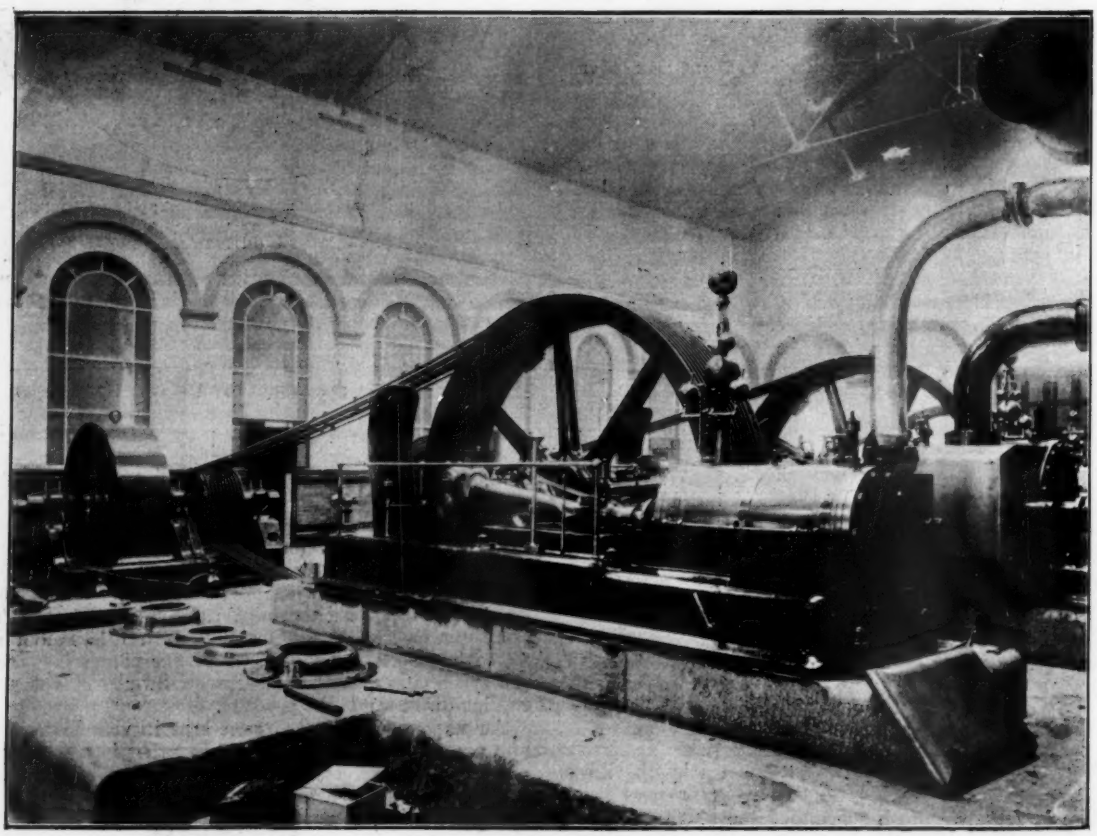
A room off the generating room is specially set apart for the switching arrangements. The switchboard is of the type common to House-to-House Company stations, it being of the Lowrie-Hall pattern. The instruments are all mounted on bases of polished slate. By this arrangement each block with its instrument can be removed at once for repair. The measuring instruments are of Nalder's make, the switches, fuses, regulators, &c., being made by John Fowler & Co., Limited. The three circuit panels contain a main fuse, main plug switch, Lowrie-Hall leakage detector, ammeter and voltmeter, giving the voltage at the sub-stations. The alternator panels contain, in addition, a field switch and ammeter. On a separate board are the pilot transformers, the synchroniser, and a high-tension Swinburne voltmeter, reading direct across the bus bars.

An important point has been kept in view both in the switchroom and dynamo room, *i.e.*, the impossibility of obtaining a shock from accidental contact with a high-tension conductor. A fairly good idea of the arrangements of the switchboard will be gathered from the diagrammatic sketch on page 130.

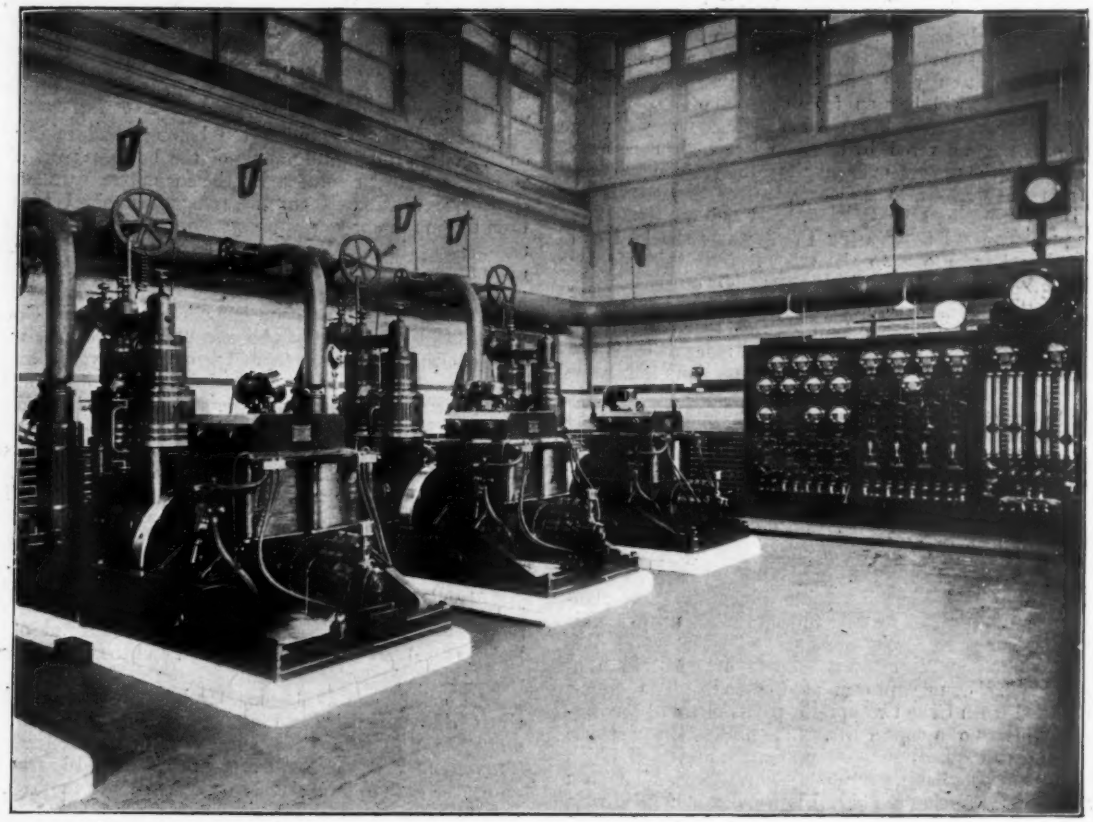
Means are taken to properly record the current passing from the station into the mains.



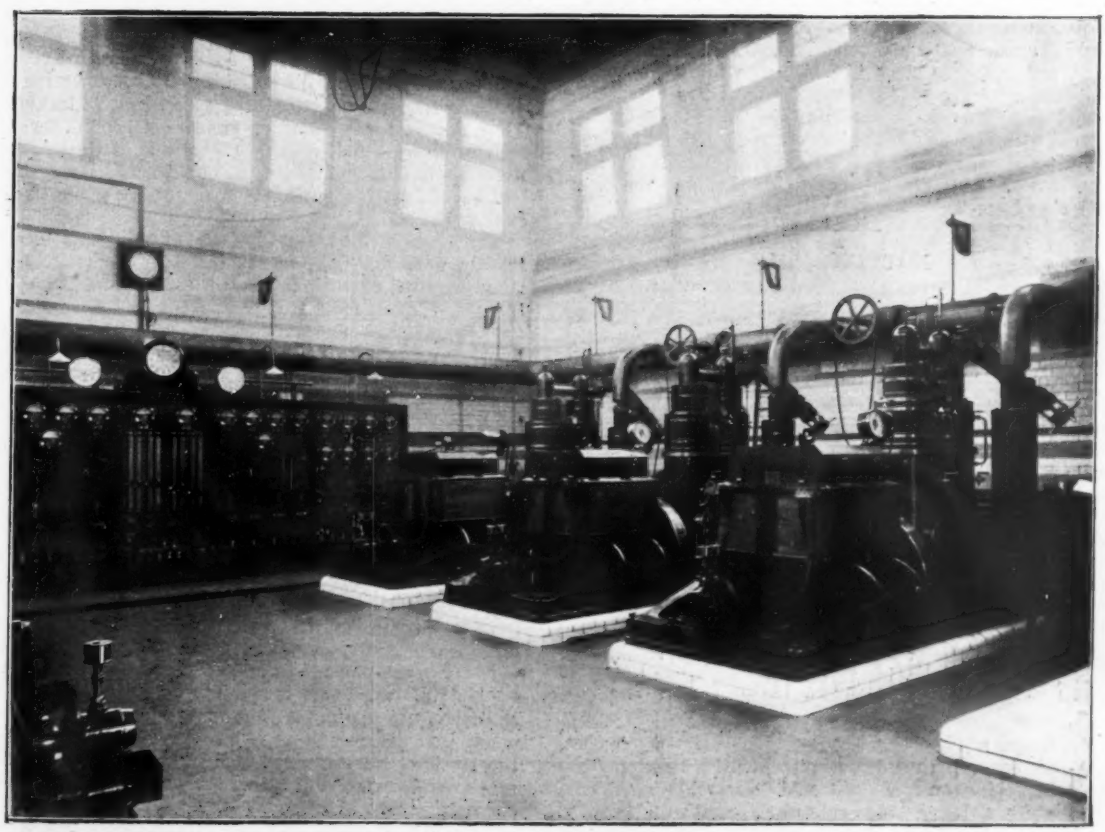
Halifax Works.—General View.



Halifax Works.—View of Engine and Alternator.



One View of the Nottingham Works.



Nottingham Works.

THE DISTRIBUTING SYSTEM.

We have already said that the high tension feeders pass to transformer sub-stations from whence a low tension area is supplied, and that outlying streets are dependent on house transformers. It will be seen from the map of the district which we give, that the low tension area is not yet very extensive, the area covered by the map being about a mile each way. At the present moment three high tension feeders pass from the works into the town, two of these run into what is termed No. 1 sub-station, shown O on the map; they are so arranged that during the daytime the load can be transferred from one to the others. The third feeder passes into No. 2 sub-station, shown O on the map, though it is intended to run a second one into this, the conditions will then be similar to those of the other sub-station. Each sub-station supplies at the present moment three low tension three-wire circuits. Eight high tension circuits for house transforming also radiate from the sub-stations. It should be mentioned that of the sub-stations one is in a stone cellar underneath the Town Hall and the other has been excavated underneath the ground. They are fairly roomy and easy to manage. An illustration shows the arrangement of high and low tension switches. Each of the high tension circuits for feeding outlying streets is provided with a double pole main switch, and any street main can be isolated for testing purposes. Besides this, Mr. Wilmhurst has designed a special form of disconnecting switch which fitted into manholes renders it possible to still further break up a circuit for testing purposes. We illustrate an elevation of this form of switch which consists of two upright pieces of copper having double prongs at the end. The circuit is completed when these two upright pieces of metal are connected by means of a copper bar. The illustration shows the connection made by the piece of copper, the middle of which is well insulated by means of an ebonite handle. The box in which these switches are placed is usually half filled with compound which sufficiently insulates the various parts.

At each of the sub-stations are four Parsons transformers, each of 20 kilowatts. They work in oil and are very cool, and at full load are quite silent. The feeders are single conductor and in two sizes, viz., 19/14s and 19/16s. They are insulated with pure and vulcanised rubber, and taped to stand a working pressure of 2,000 volts. These feeders are drawn into 2½ inch cast-iron pipes, in which also are the separate pilot wires consisting of 7/20 strand insulated with rubber. The distributing network consists of single conductor cables, insulated with pure and vulcanised rubber, and taped to stand a working pressure of 2,000 volts. There are two sizes, 37/14s and 37/19s; these are also drawn into cast-iron pipes of 4 inches diameter.

NOTTINGHAM.

The Nottingham Corporation Electrical Works, which have been in existence a little over three months, have already more than justified their existence. The working figures up to the end of December show unmistakably that they have entered upon a prosperous career. We regret that we cannot incorporate the cost of working in the present article, but we must content ourselves with saying that they have more than paid their way, and trust that in a future issue we shall be permitted to place detailed accounts before our readers.

The Nottingham system is a low tension three-wire one, with accumulators, and the most ardent supporter of such a system would be more than satisfied in the success achieved here.

Turning up the history of the scheme, we find that after the electric lighting committee had received reports from Messrs. W. H. Preece, C.B., and Dr. John Hopkinson, F.R.S., in 1890, they, before deciding on the matter, inspected several lighting stations in the Metropolis and provincial towns.

Mr. Preece advised the low pressure, continuous current, three-wire system, but if it was the intention to supply the whole borough from one generating station, he considered that the alternating system would be the most suitable. Dr. Hopkinson advised the low tension, continuous current system, with mains laid on the five-wire system. The supply to commence as a three-wire system, and to be changed to five-wire as the area had to be increased.

There is wisdom among a multitude of counsellors, so nothing further was done by the committee until 1892, when they advertised for a resident engineer. Mr. H. Talbot, M.I.E.E., then resident engineer of the Chelsea Electricity Supply Company, was selected, and he commenced his duties on July 1st, 1892.

After carefully inspecting the borough, and taking into consideration the lighting hours of the business parts of the town, Mr. Talbot recommended the committee to adopt the three-wire continuous current system, combined with the high tension motor generator system. A suitable site at a reasonable price was found near the centre of the town, and after the sanction of the Council was obtained, plans were prepared for the necessary works.

In the meantime the Council applied to the Local Government Board for sanction to borrow £45,000 for the works. It is one thing, however, to apply to this body, and another thing to get it to move, still an inquiry was held in May, 1893, but power to borrow the capital was not obtained until the following August. As soon as the tardy sanction was obtained, the committee advertised for tenders for the buildings, and also let the contracts for the generating plant.

The station is situate between Talbot Street and Wollaton Street, and has an area of 2,781 square yards.

On the ground floor are—Committee room, engineer's office, general office, cable stores, fitter's shop, oil store, tool house, lavatories, &c. On the first floor—Meter room, store room, and a large room for exhibiting various kinds of electrical apparatus. These buildings are constructed of red brick with Derbyshire stone dressings, and the roof is covered with red Staffordshire tiles.

The boiler house is 64 feet long by 47 feet wide, and has three Lancashire boilers 28 feet long by 7 feet diameter, with space for a fourth. Coal bunkers adjoin the boiler house. The chimney is constructed of brick, and is 160 feet high above the ground level; it is octagonal above the base, and is terminated by an iron cap.

The generating room is well laid out, and is the very pink of neatness. It is 40 feet long by 40 feet wide, and contains six engines and dynamos of the Siemens-Willans type, with space reserved for two additional engines and dynamos.

The foundation for the engines is composed of a continuous block of cement concrete 8 feet deep, and the whole is bedded on four layers of hair felt, in the hope that vibration will be prevented from being carried to the neighbouring walls.

Three steel boilers (Lancashire type), each 28 feet long by 7 feet diameter, for a working pressure of 150 lbs. per square inch, are fixed. A Berryman heater and a Green's economiser are used in connection with the feeding arrangements.

Two of Pearn's quadruple acting pumps are fixed for feeding the boilers.

The whole of the steam pipes are of mild steel with electrically welded flanges, and branches. The main forms a ring round the engine room, and is fed at three points from the boiler room main. We should like to mention that the steam pipes for this central station were supplied by Messrs. Lloyd & Lloyd, of Birmingham, and consist of about 30 pieces in all, made by their well-known electrical welding process. The pipes round the engine-room are 8 inches in diameter, and the connections to the boilers 6 inches. The flanges on all these tubes are electrically welded, and afford a good example of the work that can be done by this process. At the back of each flange there is a fillet with a radius of about an inch, adding enormously to its strength; this also applies to the outlets.

This is one of the many installations which Messrs. Lloyd and Lloyd have now supplied with electrically welded steam tubes and fittings, and gives an additional proof of the satisfactory way in which these contracts have been carried out. When the dangers connected with the use of C.I. for high-pressure work, and the expense and uncertainty of copper are taken into consideration, it is most satisfactory to know that such work as this can be turned out in iron and steel, and at a price which brings it within the reach of all engineers. Messrs. Lloyd & Lloyd have now several contracts of a similar nature on hand for large engineering firms.

The valves throughout are Hopkinson's parallel slide valves, and in the engine room one is placed in the main between each pair of enignes. These valves are placed horizontally, and are worked by endless chains and chain wheels.

The engines are of the Willans central valve type, compound single acting, having all brasses in constant thrust. There are three of 80-I.H.P., and three of 134-I.H.P.

The dynamos are of the Siemens type, shunt-wound, with single magnetic circuits, and bar armatures. There are six machines of the following output:—

Three dynamos, each of 370 ampères at 220 volts.
Three „ „ 330 „ 145 „

They are mounted on combination frames, and coupled direct to the fly-wheels of the engines.

The battery of 112 cells was supplied by the Electrical Power Storage Company, and is capable of giving 150 ampères at 212 volts for seven hours, or on emergency, 500 ampères at 210 volts for one hour.

The central station switchboards were supplied and erected by the Electric Construction Company, Wolverhampton, and are constructed of slate panels, five in number, fixed on an iron framing. The two end panels are for the feeders, and have upon them the ammeters and voltmeters, fuses, and pressure regulating switches, so that the pressure at any of the feeding points can be adjusted to suit the requirements of the district. The pressure is effected by cutting out or putting in cells in series with the feeders. The two intermediate slate slabs are the dynamo panels, one for the large dynamo and one for the small, and contain automatic cut-outs to protect the dynamos either from an excess current or from a reverse current. Ammeters, voltmeters, fuses and field regulating and breaking switches are also mounted on the dynamo panels. The centre panel contains the battery regulating switches and has also an arrangement for connecting the small dynamo, so as to charge either of the two batteries, or for connecting them to either side of the middle wire to assist in balancing.

Mains.

The whole of the mains have been laid on the Callender-Webber drawing-in system. The present plant installed is capable of running 10,000 8-C.P. lamps at one time.

There is sufficient spare ground to double the size of the station.

The mains laid at present extend through 20 streets, having a total of two miles of frontage, with shops and business premises the whole way.

Applications have been received equivalent to 5,786·8-C.P. lamps (November 9th, 1894).

The buildings have been designed by the borough engineer, Mr. Arthur Brown, M.I.C.E., the whole of the engineering and electrical work by Mr. H. Talbot, the resident electrical engineer, who has also superintended the laying of the plant.

It will be seen from the subjoined curves that fairly good loads are obtained; the curious sudden rise and fall about 9 o'clock p.m. in one of the curves was due to an electric ballet at the pantomime. With regard to street lighting, no definite decision has been arrived at; the corporation had four arc lamps erected as an experiment in the Market Place, and we understand that they are satisfied with the performance of these lamps.

We ought to mention that Ferranti meters are used on consumers' premises. The table attached herewith shows the steady increase in the lamp connection which has prevailed since the station was opened.

Lamps Applied for per Week from September 18th, 1894. 8 C.P.

September	18th	3,164	= 3,734
„	25th	570	
October	2nd	440	
„	9th	52	
„	16th	318	= 1,765
„	23rd	833	
„	30th	122	
November	6th	314	
„	13th	256	= 965
„	20th	223	
„	27th	172	
December	4th	542	
„	11th	176	= 1,120
„	18th	212	
„	25th	190	
January	1st	40	
„	8th	178	= 346
„	15th	128	
		7,930	

The inside work is carried on with an exceptionally small staff, which consists of a stoker, a fitter, who also acts as driver, and a cleaner. The outside work, such as connecting up houses to the mains, is done by a man and boy.

Most of the consumers at the present time are shopkeepers, though the mains are being extended into the residential districts where there is a demand.

DEWSBURY.

The electric light works of the Dewsbury Corporation are the next we desire to speak of. We should have thought that as a district Dewsbury would have been better supplied with a high pressure system than a low pressure one, but we take it that the area in which a demand for electricity could be reasonably expected is a small one. Dewsbury can scarcely be considered a residential district; certainly people live there, but they are not likely customers for electric lighting. Beyond the shopkeepers in the centre of the town and the offices round about, we do not suppose the corporation look for much consumption of electricity, and this may constitute a good reason for adopting a low pressure system.

The works have been laid down on a low-tension three-wire continuous currrent system, with accumulators. The charging of the accumulators is one of the interesting features of the work, because it brings into operation the much spoken of "booster" system.

The Corporation were much fluttered some six years ago by the threatened introduction of electric light into the town by joint stock companies. It, however, had the effect of urging the Corporation to prompt action, and they determined to apply to the Board of Trade for a Provisional Order. In 1891, at a meeting of the Town Council, it was resolved that the Gas and Water Committee be appointed the Electric Lighting Committee to carry into effect the provisions of the order. After searching the country for information, Mr. W. H. Preece was engaged to prepare a report on the subject. After much consideration it was decided to adopt a low-pressure three-wire system. A site has been found on the ground formerly occupied by the old gasworks.

In the boiler house, which is considerably below the level of the generating room, are three Lancashire boilers, 7 feet by 28 feet long, which work at a pressure of 150 lbs. per square inch. These boilers are equipped with St. Clair's mechanical stokers of the coking type, the stoker being fed with coal automatically by means of conveyers. The stokers are driven by two small horizontal engines of the ordinary pattern, one being a stand-by. The coal when entering the furnace is gradually pushed from the stoker by movable bars, the coal first coming into ignition at the front end of the fire box, the gases passing over the remaining length of grate bars of bright hot fire, therefore consuming the smoke.

There are two feed pumps of the Duplex type, each capable of delivering 2,500 gallons per hour at a piston speed of 100 feet per minute. These pumps are fed with cold water when working non-condensing, and force the water through the Green's economiser. There is also an exhaust steam feed water heater.

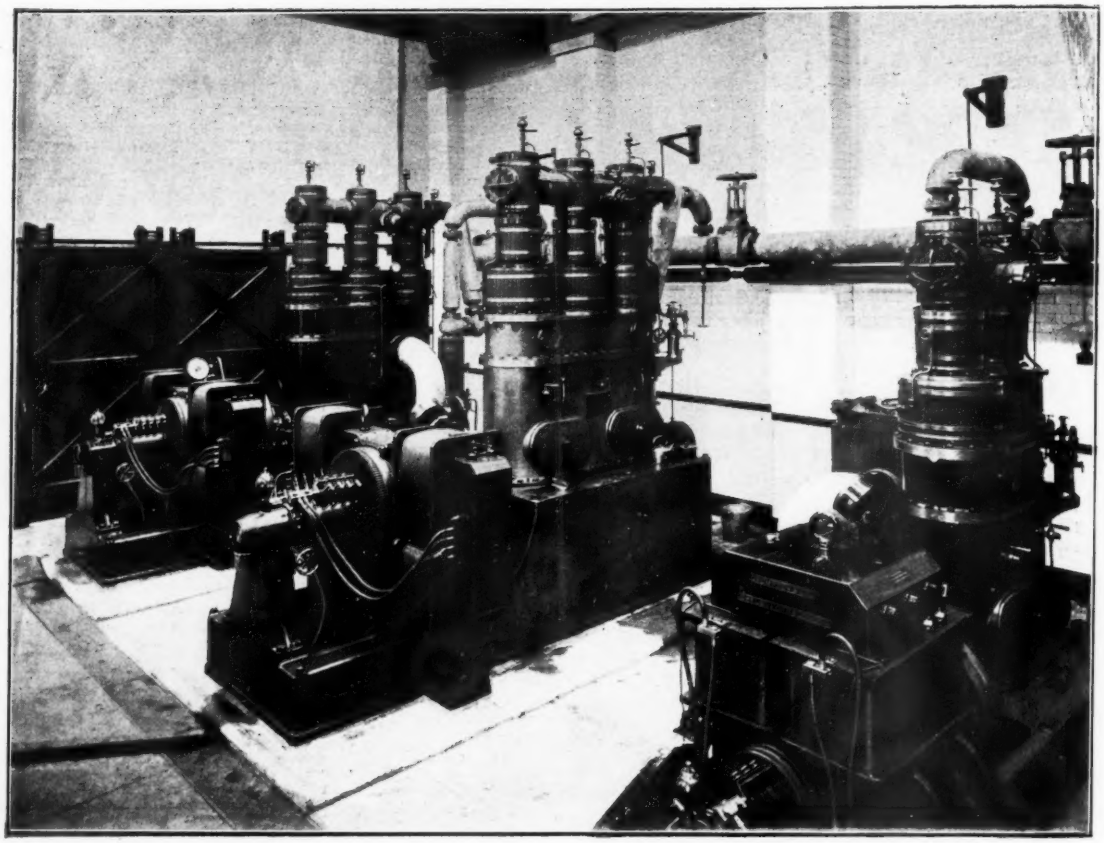
The station at the moment is running non-condensing, but it is intended to use the town water for condensing purposes later on. A condensing plant has been put down by Messrs. W. H. Allen & Co.

The steam piping is arranged on the ring system. The boilers and pipes are covered with a non-conductor, which is made and supplied by the M. and C. Stores Company, Dudley Hill. It is composed mainly of animal fibre and fire-clay, and seems to serve its purpose admirably.

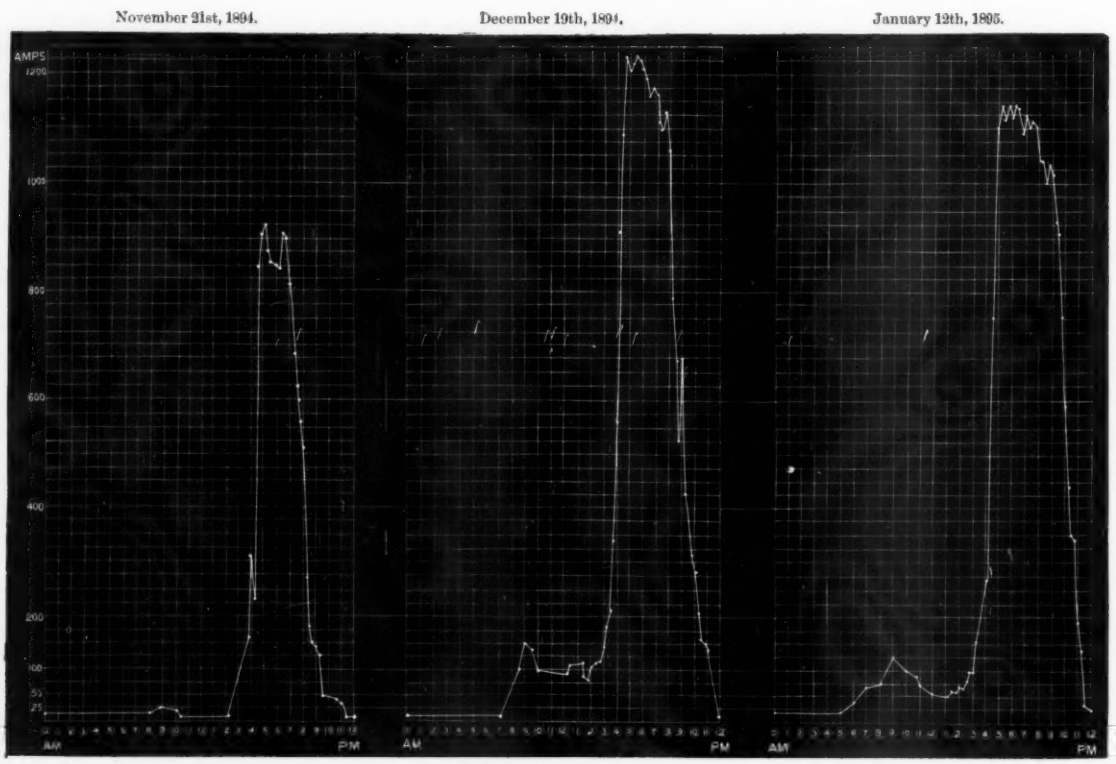
The engines are three in number, and are of the Willans type. Two are capable of developing 180 indicated horse-power with a steam pressure of 140 lbs. per square inch when running at a speed of 460 revolutions per minute. The smaller one is capable of developing 80 indicated horse-power at 460 revolutions per minute at the same pressure of steam, viz., 140 lbs.

The three dynamos are by Messrs. Crompton & Co.; the two large ones are of the four-pole type, and have an output of 400 ampères at 250 volts. The small dynamo is of the two-pole type, and has an output of 200 ampères at 250 volts.

The switchboard is divided into three panels; the left-hand side panels have positive connections; the right-hand side panels, negative connections. The centre panel contains



Dewsbury.—View of Engines and Dynamos.



Three Load Curves of the Nottingham Works.

the neutral or centre wire of the whole system, four spare panels being left for further extensions. The top part of the switchboard is arranged for the feeding mains which carry the current to various centres of the town. The main dynamo switches are arranged at the bottom of the board. On the spare panels are two ampère-hour meters which register the total amount of electricity leaving the works. The usual meters for the batteries are supplied.

The storage batteries are of the Crompton-Howell type, there being 130, each cell containing 21 plates. The battery is divided into two equal parts of 65 cells each. The storage capacity of the cells is 170 ampère hours. The batteries are charged by means of motor generators.

The mains are by Messrs. Siemens Bros., London, the feeders being concentric conductors insulated with specially treated jute yarns, cased in lead, served and compounded, and sheathed with steel bands. A portion of these cables have three concentric conductors each, while the remainder have only two.

The distributing mains are single conductors, insulated, cased and sheathed as above.

The arc lighting mains are India-rubber cables. The conductor is a 7/17 strand insulated with pure and vulcanised rubber, taped, served, and sheathed with galvanised steel wires.

At the present moment there are four feeding points, the distributing pressure at these points being 110 volts. There are 25 customers with an aggregate of 2,471 8-C.P. lamps connected. The price per B.O.T. unit is 6d.

Two or three arc lamps have been erected as a small experiment in street lighting.

We are obliged to the resident engineer, Mr. J. B. Mitchell, for much of the information given above.

The whole of the station has been designed and superintended by Messrs. W. H. and A. H. Preece.

BUSINESS NOTICES, &c.

Aberdeen.—A short-sighted old lady about the middle of last year, while walking along one of the public streets, stumbled against some earth lying on the pavement, and fell into an excavation which had been made by the Town Council's employés for laying down electric lighting mains. Since then she has been continually under medical treatment, and has been informed by her medical man that she will never fully recover from the effects of the accident. She now claims £100 from the Council as damages.

Aberystwyth.—The ratepayers the other day discussed the question of the defective lighting of the town.

Bath.—The electric light behaved itself far better than the gas during the floods which occurred some weeks back, and in consequence the Town Council have resolved not to fine the electric light company for any failures which were occasioned through the flood. Several members of the Council now consider that the gas company should be placed on an equal footing with the electric light company as regards fines for failures, but from the remarks of the chairman it seems that the Council has no power to fine the gas company. It was stated at the last meeting that there is to be a fresh arrangement made with the gas company, "when the proper time comes." This should have been done long ago, or the fines of the electric light company should not have been imposed. The Electric Light Company has been scandalously treated at Bath.

Brighton.—Some shareholders in the Brills Bath Company think the baths might be made more attractive by lighting them by electricity.

Bristol.—The disused gas lamps are to be removed, as it is considered that electricity can be relied upon.

Douglas.—Some of the Commissioners want to know when the Health Committees' report on the lighting of the front by electricity is likely to be received. The surveyor is to collect information as to the lighting of certain streets with incandescent gas.

Ealing.—The electric lighting committee have reported that 64 applications have been received for a supply of current to 4,033 lamps. Fifty-four of these, with a total of 3,375 lamps, had been connected to the mains. Sixty-three of the public arc lamps have been erected. The engineers, Messrs. Bramwell and Harris, have been instructed to furnish a report as to the amount already expended upon the electric lighting scheme, also the probable further expenditure.

Fermoy.—Mr. Thomas Tomlinson has now presented his report to the Town Commissioners. He considers water-power will be available on fair terms. He mentions two systems. The first, which is a low tension, would cost £7,000, this sum including buildings, turbine, engine, gas-making plant, dynamos, storage battery, mains, arc lamps and posts, and other accessories. The earning power of this plant is estimated at about £1,400, and the running cost £860. The other system, which is the high tension, would also cost £7,000, and this sum would include all plant, lamps, &c., as in the other scheme; the earning power of this system is estimated at £900 to £1,000, and the running cost about £995. These figures are for only a certain selected area which is likely to prove more profitable than any other. Mr. Tomlinson would prefer "not to be compelled to advise the high tension system," though exceptional circumstances might necessitate that course being adopted. He suggests a charge of 8d. per unit. The present gas lighting is said to be abominable, notwithstanding the high price, *i.e.*, 5s. 10d. per thousand. Mr. Tomlinson makes a very good suggestion, when he recommends the Commissioners, and those supporting the enterprise, to act from the outset in concert, and under professional advice; also to arrange with a single good contractor to carry out the work. The Commissioners are to consider the report shortly.

Heanor.—The large new dye-house of Messrs. I. & R. Morley has been fitted up with the electric light. In the laboratory are two 2,000-C.P. arc lamps, worked by a dynamo driven from their own engine. The work has been carried out by the Electric Wire and Fittings Company, of Nottingham.

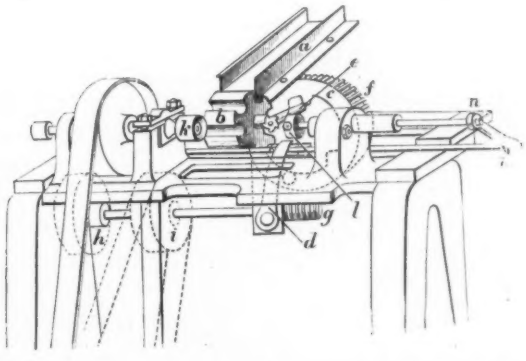
Lambeth.—The Vestry are to meet in three weeks time to specially discuss the question of setting to work under their provisional order.

Llanelly.—The surveyor has been instructed to obtain further particulars regarding the electric lighting of the new Town Hall, Market Hall, and public buildings. The architect has also been instructed to obtain a note of the probable cost of wiring the new Town Hall for electric lighting, also the cost of gas fittings for same.

West Cowes.—A committee appointed to consider whether a company's application for laying electric light mains should be granted, has reported that if the inhabitants want the light the Council should supply it. The Council has referred the matter back for the committee to collect information.

Woking.—There are to be thirteen additional electric lamps erected in a number of streets.

A Cartridge Closing Lathe.—The Electrical Installation Company have recently introduced an automatic lathe for turning over the ends of cartridges. The feed is by gravitation in an open shoot, and an uniform pressure for the turnover is secured by adjustable tension of a spring operating the rod of the cartridge holding disc. In the illustration, the feed hopper in which the cartridges are placed by hand, is shown at *a*; *b* is a rotating feed-carrier having divisions into which the cartridges fall from the hopper; *c* is a feed cam wheel, which in rotating engages with the lever, *d*, and carries the cartridge-holding disc, *l*, to and from the turning over chuck, *k*, in the



lathe head. The guide-rods, *n* and *m*, ensure the exact working of the cartridge-holder in the poppet head. The capacity of the machine when driven by an electric motor, as used by Mr. Lancaster, of New Bond Street, is 3,000 cartridges an hour, the cost of current for an hour being not much more than a penny. The first machine made has been working at Mr. Chas. Lancasters' for over a season, and has rounded over one million and a half (1,500,000) cartridges to date with perfect satisfaction, doing 2,500 cartridges an hour.

Calendars.—Mr. J. H. Sankey, maker of stoneware goods for sanitary and other purposes, of Canning Town, E., has sent us a hanging date calendar for 1895.

The Automatic Standard Screw Company, of Halifax, have brought out a small and neat calendar card for 1895.

Catalogues, Price Lists, &c.—From the Electrical Company, Limited, we have received a copy of their new catalogue of electric light fittings and glassware. There are described, accumulator sets, electroliers, pendants, billiard fittings, brackets, standards, ceiling lights, and of these there are a variety of designs, some of the better ones being very artistic. The last few pages are devoted to reflectors, shades, and electrical accessories. Nearly every article is illustrated, and the catalogue has been very nicely got up.

Messrs. W. F. Dennis & Co. have forwarded to us a copy of their 1895 catalogue in which they deal in detail with the

various manufactures of Messrs. Felten & Guilleaume, for whom they have long been sole agents in this country. Wire mats, fencing, cords, ropes, and all kinds of wires, including telegraph and telephone, are particularised. The Bleichert patent improved wire ropeways are described and illustrated at the end of the book, as is also the Dennis patent tubular telegraph pole. Most of the articles dealt with are priced and illustrated, and the catalogue is a nice production.

Messrs. Gebruder Adt, of Ensheim, have sent us a copy of their catalogue, printed in German, in which are given prices of various electrical articles. Tubing for carrying electric lighting wires, T-junctions, tube carriers, accumulator boxes, &c., are included in the articles described and illustrated. The book is a very neat production. The front cover bears a very nice piece of artistic work printed in several colours.

From Messrs. W. T. Glover & Co., we have received lists of their patent portable cure for vulcanising inside joints, new electrician's wire gauge (Poole's patent), note of the stocks kept of electric light wires and cables, &c.; also an illustrated list showing Glover's patent improved anti-induction telephone cable.

The Consolidated Telephone Construction and Maintenance Company have sent us their latest illustrated sheets of telephone apparatus. There are some nice blocks of transmitters, receivers, bells, and general telephone accessories in the lists.

A very good catalogue has been issued by Messrs. Thomas Parker, Limited, of Wolverhampton, which is devoted to illustrated and detailed descriptions of continuous current dynamos. Some very handy details are given in tabular form regarding the various sizes of dynamos. The printing is well done, and the general get-up very neat.

Messrs. Gent & Co., of Leicester, have sent us sections 1, 2, and 3 of their new catalogues. Section 1 contains practical instructions for fixing and repairing electric and pneumatic bells, speaking tubes, lightning conductors, &c., and also gives prices and illustrations of these articles and their accessories. Section 2 contains practical instructions for fixing telephones for every variety of purpose, and likewise contains prices and illustrations of the many things needed for the purpose. Section 3 contains practical instructions for electric lighting from private plant or town supply, and also contains tables and diagrams for fixing. This section further gives prices and details of a large number of electric light fittings and accessories, and particulars of heavier plant such as gas and oil engines. This is a very handy and useful set of pamphlets.

From the Chloride Electrical Storage Syndicate, Limited, we have received one of their 1895 catalogues describing the chloride accumulator and its applications. A great deal of tabulated information going into detailed figures as to the capacity, rate of discharge, &c., &c., of the batteries is given. The list also contains prices, and at the end gives particulars regarding the specific resistance of sulphuric acid solutions, and a table showing the percentage of sulphuric acid in solution and its corresponding specific gravity, also its equivalent in degrees Baumé.

Messrs. Nalder and Harrison Construction Syndicate have brought out a price list which illustrates their ammeters, voltmeters, portable testing sets, and large switch and fuse boards.

A small catalogue of steam launches, nicely got up, has been brought out by Messrs. Weston & Co., of Dover.

Chadburn v. Mechan.—Last week a case came before Mr. Justice Romer, in the Chancery Division of the Law Courts, in which Messrs. Chadburn sought to restrain the infringement of a patent for improvements in telegraphic signalling on board ship. Evidence was given by Messrs. Dugeld Clark, Arthur Mechan, Imray, Swinburne, and others, and the hearing was adjourned.

Change of Address.—Howard B. Little & Co., late of 20, Eldon Road, Kensington, W., inform us that their present address is 36, Shaftesbury Avenue, W., to which all communications should be sent.

Coast Communication.—The scheme recommended by the Royal Commission having been sanctioned by the Treasury, telegraphic and telephonic communication in connection with the Liverpool lifeboat service has been established by the Post Office authorities, under the supervision of Mr. J. R. Edwards, the Department's Superintending Engineer. The new system provides telephonic intercommunication between the lifeboat station at Formby, the coastguard station at Blundell Sands, the Prince's Landing Stage, the Ferry Stage at New Brighton, and the Liverpool head post office, besides telegraphic communication between the latter office and the "look-out" stations at Voelnant (Point of Air), Hilbre, Hoylake, Bidston, and the Crosby lighthouse. On the Welsh coast the lighthouses on the Great Orme's Head and at Menai are now placed in communication with the lifeboat stations at Llandudno and Penmon respectively. The lighthouse on the South Stack, the signal station on the North Stack, and the lifeboat stations at Rhosneigir and Rhoscolyn are in direct telephonic communication with the coastguard station at Holyhead. The work of providing telephonic intercommunication between the coastguard station at Amlwch and Cemmaes, the signal station at Point Lynas, and the lifeboat stations at Bull Bay and Moelfra (the scene of the wreck of the *Royal Charter*) are nearly perfected, as is also a telephonic extension to the lifeboat station at Llanddwyn, Carnarvon Bay.

Commercial Cable Company.—This company have sent us one of their calendars for 1895. In addition to the usual calendar information there are given some interesting details regarding the company's system. On the first sheet are some statements showing what the Commercial Cable Company have done during the ten years of their existence for the telegraphing world of the United States and Europe. The calendar has a separate detachable sheet for each week. The company claim that no other concern owns and operates a completely submarine telegraph line between New York and the continent of Europe. The company also claim that their routes are shorter between London and Liverpool, and New York and Boston than those of any other company, avoiding all long land lines on both sides of the Atlantic. The Atlantic cable added to the company's system during 1894 is considered a most important addition. Rules for counting, rate per word, business holidays in Great Britain, France, and America, differences in time of transmitting messages between the United States and the important cities of the world, length of cable routes between London and New York, are among the subjects to which separate sheets have been devoted in this very useful calendar.

Dublin Tramways and Electricity.—At a special meeting of the Dublin United Tramways Company last week, the shareholders approved of the introduction of a Bill providing for the use of electrical motive power in the Dublin street cars. The chairman (Dr. Carte, J.P.) said they had examined the systems in use in Paris, Brussels and Frankfort, and had come to the conclusion, from what they saw, that the days of horses in street cars were numbered. The electric system was better and cheaper, and they hoped that the Dublin Corporation would give them every assistance in introducing it. They believed, from what they saw, in the system of overhead wires, and they intended, if power were given, and subject to the advice of experts, to introduce it on the Clontarf line.

Exhibition Lighting.—On Monday afternoon, Messrs. Rashleigh Phipps & Co. received instructions to light the 24 stalls of the Book, News and Fancy Goods Trades' First Annual Exhibition at the St. Stephen's Hall, Royal Aquarium. The whole of the work was finished by the following morning, the number of lamps fitted being nearly 200.

"Electric Light Explosions, and how to Prevent Them."—Mr. A. L. Fyfe, of Electric Avenue, is sending out the following communication to the Press:—"As I was the first in London to lay electric light cables underground for the use of business establishments, my experiences with explosions, and the simple means adopted to stop them, may be of service. Our first explosion occurred in the year 1882, in the Brixton Road, near the Bon Marché, and as there were then no Board of Trade inquiries on electric lighting, the matter dropped; but when we had a second, and shortly afterwards a third explosion, something definite had to be done to stop any further chance of accident. I was then convinced that the explosions arose principally from want of proper ventilation in the porcelain pipes through which the electric light wires were laid, and I adopted the simple plan of ordering the lids of each trap to be lifted for a few minutes every morning; but finding daily attention troublesome, we perforated a few of the covers with a drill, and after this was done the explosions ceased. In all cases where electric light mains are laid in underground conduits, the ventilation ought to be good, and means provided for accumulations of water to gravitate into the sewers. Where communications with the sewers are not allowed, 'sump' holes or tanks ought to be sunk to receive the water, which could be pumped out at intervals. If these precautions were intelligently adopted, London would in future be free from explosions, which are caused principally through imperfect ventilation. The sparking is no doubt produced by the heavy traffic of the streets, causing the electric light wires, connected with screws in the boxes, to vibrate."

Hackney.—The question of the electric lighting of this parish came up for discussion at the last meeting of the vestry. In the course of some remarks, it was stated that the Provisional Order, obtained some time ago, expired this June, and unless the vestry took immediate action, the power would most likely be taken out of their hands, and a local company formed to exploit the matter. After several members had spoken, deprecating this latter course, it was unanimously decided to keep the matter in the vestry's hands, and re-appoint a committee to make full inquiries, and to forward this matter with special reference to the combination of a dust destructor with the electric lighting scheme.

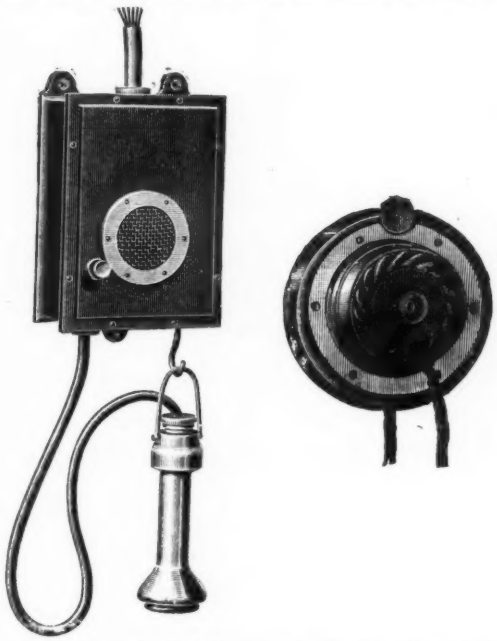
Hartlepool and Electric Tramways.—The Town Council last week considered the question of electric tramways, and resolved to approve of the proposed application to amend the Hartlepool tramway orders, introducing thereinto powers to use electricity.

Hotel Lighting.—The new "Hotel Avondale," in Piccadilly, which has been erected and furnished at a cost of £160,000, is lighted throughout by electricity.

Leeds Electric Tramways.—The tramways committee of the Corporation considered further the city engineer's report on haulage last Monday. The decision at which the committee arrived was to recommend the Corporation to adopt a system of electrical traction for the city tramways. Inquiries are to be made as to the probable cost of providing the conduit system in the centre of the city, through certain streets, including Hunslet Lane, Queen Street, and Park Row.

London County Council and Electric Lighting Loans.—At the meeting of the Council on Tuesday, the finance committee brought up a report recommending that the Council should lend the St. Pancras Vestry £14,300 for electric lighting purposes at 3½ per cent. for 20 years. Mr. Westacott suggested that the period should be for 42 years instead of 20. After discussion, the report was taken back for further consideration. The same committee recommended the loan of £18,000 for 50 years and £33,000 for 20 years to the Islington Vestry for electric light purposes. This was also taken back.

Mining and Engine House Telephone.—The General Electric Company are introducing a novelty in the way of telephones which is intended to meet the demand for a good serviceable instrument to stand a great amount of rough use, and to be also practically impervious to injury from moisture, dust, &c. These causes of danger to the proper working of telephones are to be found greatly in mines, engine houses, engineering works, &c., and it is claimed that their mining and engine-house telephone is so constructed as to be unaffected by any of the above causes. The containing case consists of cast iron with front screwed on, with Indiarubber packing between the sides and front of case. Special precautions are taken that no moisture can be admitted through the mouthpiece of transmitter, or at the point through which the switch-hook enters the case.



The receiver is constructed of gun-metal, and is a solid and substantial piece of work, calculated to stand any amount of rough usage, without being broken or injured. The flexible cord which connects the receiver with the containing case is protected by a steel flexible tube, which passes through a stuffing box into the interior of the case at one end and into the interior of the receiver at the other end. The whole of the movement inside the containing case is mounted on a slab of ebonite, so that the whole of the working parts are thoroughly insulated from the metal case. The fact that with this combination is used the "Hunningscone" transmitter, is sufficient guarantee that the speaking is both loud and clear. The General Electric Company have recently taken over the Anders Telephone Company's business, and are now selling the Anders telephone for domestic purposes. This instrument can be readily attached to existing bell wires.

New Interchangeable Telephone.—We have received particulars of the "retiring hook" system of telephones, which is

another step in the direction of simplifying and cheapening intercommunication between the different rooms or stations in large buildings, and institutions, such as, warehouses, factories, suites of offices, or on private estates. The name is derived from the method adopted to avoid the frequent annoyance caused in other "direct call" systems, by the switches being left as last used, either through carelessness, or by the springs that should return them failing to act and thus preventing another call from being made. In these instruments the receiver hook disappears into the instrument as soon as the switch is moved, and the receiver taken off, and the operator cannot therefore hang up the receiver again until the switch is put "home." The simplicity of the instrument makes it not only "workable" but cheap, and should ensure a large sale. The makers are Messrs. Gent and Co., Leicester.

New Branch.—Messrs. H. Whitney Smith & Co. (formerly Smith Brothers), of Nottingham, have opened a London office at 46, Strand, W.C.

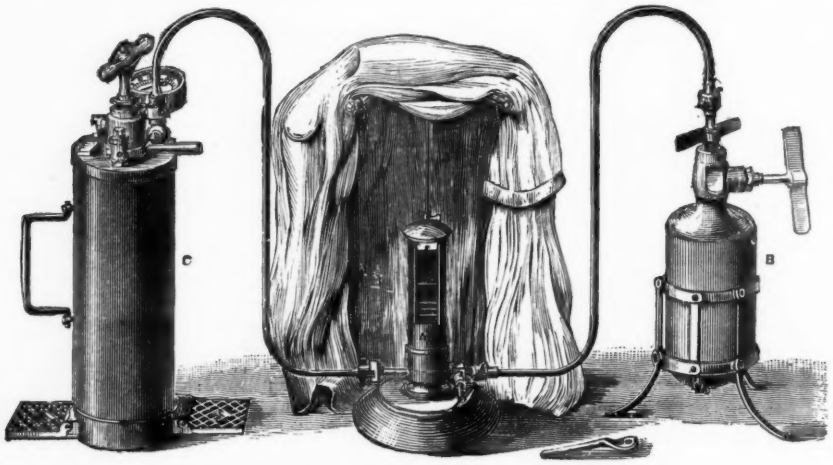
Personal.—We understand that Mr. I. H. Garratt, A.M.I.E.E., has resigned his position as chief electrician to Messrs. Ronald Scott, Limited, of Acton Hill.

South African Cable Rates.—The Exchange Telegraph Company says that, contrary to general expectation, the negotiations between representatives of the South African Powers and the cable companies, for the reduction of the cable rates between London and South Africa, have resulted in a deadlock. Hitches have occurred, one of which is the refusal of President Kruger to agree to pay the amount of subsidy required. The negotiations are, therefore, indefinitely postponed.

The Telegraph in Matabeleland.—The report of the Chartered Company recently published says that in connection with the Matabele campaign a light field telegraph was erected by the Government between Palapye and Tati, a distance of 89½ miles. An office was opened at the latter place on January 22nd, 1894, and very shortly afterwards the line was handed over to the Chartered Company, by whom it was extended to Ramaquaban, a distance of 17½ miles in a northward direction, where a temporary office was established on March 13th. From thence a wooden pole line of a more permanent character was constructed, *via* Mangwe, to Bulawayo (105 miles), at which latter place an office was opened on July 9th last. The cost of this 105 miles did not exceed £30 per mile. It has been arranged that, in return for a payment of £1,000 a year, Her Majesty's Government has the use of the wire for official messages to and from the company's offices in Matabeleland and Mashonaland. The lines between Tati and Mangwe, and between Mangwe and Bulawayo, were erected under the superintendence of the Cape Postal Department, and it has been decided, with the approval of the Government of that Colony, that the Cape Postal Department shall, for purposes of common advantage, control the working of the company's service in connection with their own. This arrangement is a satisfactory one, both for the Cape Colony and the company, as it will ensure the mutual efficient working of the line as a whole throughout its entire length, and will, at the same time, reduce maintenance expenses, and be generally more economical. Upon the line reaching Bulawayo it was immediately decided to push forward the extension to Charter, *via* the township of Gwelo, a further distance of 212 miles, and thus place Bulawayo in direct communication with Salisbury. This stretch of country is a part of the most favoured mining and agricultural region of Matabeleland. It is anticipated that this branch will be opened for traffic before the close of the present month. In order to strengthen the chain of telegraphic communication northward it has been decided to erect a short alternative iron pole line from Macloutsie to Mangwe, about 112 miles; this line is now in course of construction. A line will also be carried from Salisbury, *via* Umtali to Chimoio, the Beira Railway terminus, a distance of about 215 miles, thus placing Cape Town, Bulawayo and Salisbury in communication with Beira. A very considerable revenue may be looked for from this extension. The total number of miles of telegraphs—exclusive of railway service lines—worked and owned by the Chartered Company south of the Zambesi is now 1,225, and on the completion of the proposed extensions it will represent a mileage of 1,551. The revenue of the company's telegraph department, which, owing to the disturbances caused by the late Matabele war, only showed a net return for the 12 months ending March 31st of £370, now shows, after the pacification of the country, a net revenue of £2,755 for the six months ending September 30th. It is interesting to note that, during the month of October last, the gross revenue derived from the Bulawayo Telegraph Office was £527, showing the rapid growth and development of that town. Good progress has been made with the work of construction by the African Transcontinental Telegraph Company, Limited, of that section of the line to Uganda which is to connect Salisbury in Mashonaland with the company's possessions north of the Zambesi, bringing Nyassaland, British Central Africa, and ultimately Lake Tanganyika, in direct communication with the Cape, and thereby Great Britain. The survey of the section from Salisbury to Zomba (400) has long since been made; the materials for the subdivisions north and south of the Zambesi has been sent forward, and about 313 miles of line have been completed. This includes the section of 180 miles from Biantyre to Tete, and that northward from Salisbury as far as the Mazoe River, where telegraph offices have already been opened.

Testing for Gas in Electric Light Culverts.—A letter which recently appeared in our "Correspondence" columns from the pen of Prof. Clowes, referred to the Redwood testing set as a suitable apparatus for the detection of gas. We are now in a position to give some further particulars of the set, which is manufactured by Messrs. W. J. Fraser & Co., Mr. Boverton Redwood, F.R.S.E., &c., being the inventor. In a paper read not long ago before the Institution of Civil Engineers on the "Transport of Petroleum in Bulk," Mr. Redwood says that as the outcome of certain experiments he, with the

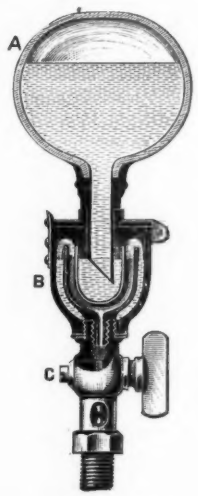
assistance of Messrs. Fraser devised a form of hydrogen testing lamp, suited for use on board petroleum tank-steamships, as well as elsewhere, and apparatus for the collection of samples of air for testing. The lamp and its accessories have now been in practical use for some time past, and have been found to answer the purpose very well. The complete appliances are shown in the illustration. They consist of the lamp, A, the reservoir of compressed hydrogen, B, and the sampling vessel, C, in which the sample of air for examination is collected. The hydrogen inlet-tube has a regulating valve and a



hydrogen jet. The bore of the inlet-tube, which is for the sample of atmosphere to be tested, is greatly contracted, and immediately above the point at which this tube enters the base of the lamp is an arrangement of baffles, surmounted by three discs of wire-gauze of at least 28 wires per lineal inch, or not less than 784 openings per square inch, the flow of the gaseous mixture to the flame being thus regulated, and passage of flame into the collecting vessel being prevented. The chimney fits air-tight at the base, but is capable of vertical movement on an inner tube, the front of which is removed. The chimney is partly of metal and partly of glass, the metallic portion being blackened inside, and on the glass window lines corresponding with various heights of flame-caps may be marked. The top of the hydrogen jet-tube is 10 millimetres (0·4 inch) below the bottom of the window. Attached to the base of the lamp is a telescopic support for a cloth, which envelopes the head of the observer and excludes light when the testing apparatus is used in an undarkened room. The compression pump is furnished with a metallic spring-piston, fitting the pump-cylinder without the use of leather or other material, and lubricated with plumbago. Surrounding the pump is an annular space, in which the sample of atmosphere is stored. The capacity of the pump is 14·84 cubic inches, and of the annular space 169·14 cubic inches, thirty double strokes of the pump being required to charge the vessel to a pressure of 30 lbs. per square inch, when it will contain ⅓rd cubic foot of the atmosphere sampled. It is desirable that the collecting-vessel should be fitted with a relief valve, as the apparatus is often used in places in which the dial of the pressure-gauge cannot be easily seen. Having regard to the well-known experiment of the ignition of a piece of tinder placed beneath the piston of an air-compression syringe, the author thought it expedient to ascertain the rise of temperature resulting from the compression of the sample, and, with the assistance of Messrs. W. J. Fraser & Co., delicate thermometers were inserted at suitable points, but the increase noted was only from 20° to 30° Fahrenheit. The hydrogen cylinder may be of any desired size, but the author has found that what is known as a 5-feet cylinder is of convenient dimensions. When charged to the usual pressure of 120 atmospheres, it holds enough gas to supply a 10-millimetre flame for ten hours, and is quite portable. The whole apparatus may be packed into two small boxes, and be readily taken on board a vessel.

The Proposed Electric Tramways in Uxbridge Road.—We hear that a petition is being largely signed against the proposal of the London United Tramways Company to extend their line from the Uxbridge Road terminus to Acton Hill by using the overhead system of electric traction.

Yorke's Syphon Lubricator.—A new patent syphon lubricator, as shown in the illustration, is being placed on the market by Mr. R. F. Yorke, of Glasgow. The glass reservoir containing the lubricating oil feeds the lower or metal reservoir through a bevel mouthed tube, maintaining therein a constant level of oil as no oil can flow from the upper reservoir unless the mouth of the tube is uncovered to allow air to enter. Immediately the oil comes down and causes a rise in level in the lower reservoir it chokes its own flow directly and once more buries the mouthpiece in oil. As soon, however, as the wicks have syphoned off sufficient oil to the bearing, so as to again expose the mouth of the tube, a bubble of air will ascend into the glass bulb, displacing a certain amount of oil. The tube again becomes air-choked, and the action is repeated. In this way the level of the oil is kept constant, and consequently the wicks will continue to feed at the same rate, until the glass reservoir is exhausted, when it may be readily replenished by throwing back the hinged top of the metal reservoir which carries with it the glass bulb. In order to regulate the flow of oil, it is only necessary to raise or lower the feeder, as according to the height it is set, the wick will syphon the oil either fast or slow. The oil box is provided with a sight-feed for counting the number of drops, which may range from two or three per minute when the feeder is at the lowest position, to 60 or 70 at the highest, or the supply may be shut off entirely by the tap, C. A flush of oil can be provided at any moment by simply opening the lid and exposing the mouth of the tube. For marine and other purposes where it may be necessary, the glass reservoir may be protected by means of a wire guard. It is claimed that by the



use of this improvement a certain and reliable means of lubrication is provided, which will run for a long time at a constant rate, thus avoiding frequent attention and refilling.

CONTRACTS OPEN.

France—February 7th. The General Direction of the French Posts and Telegraphs in Paris is inviting tenders for the supply of 850 tons of galvanised iron wire, and 251,000 galvanised iron brackets.

France.—March 31st. Tenders are being invited at the Questor's Office of the Chambre des Deputés, at the Palais Bourbon, in Paris, for the work of installing the Chambre des Deputés for electric lighting.

Newcastle.—February 2nd. The Committee of the Ryhope and Silksworth Industrial and Provident Society, Limited, are prepared to receive tenders for the installation of the electric light into their Ryhope premises. Particulars given by applying at the Stores, Ryhope.

Weybridge.—February 20th. Tenders are invited for the public lighting of Weybridge on and after September 29th, for the Urban District Council.

CITY NOTES.

Yorkshire House-to-House Company.

The first complete twelvemonths' accounts of this company have just been issued, and they certainly bear out the promise which the earlier accounts held out. In all respects the company are to be congratulated on the great efficiency which they have maintained during the past year, and they may take much credit from the fact that they have arrived at lower coal figures than any other alternating current station.

The directors' report states that on December 31st last the number of lights connected to the mains was equivalent to 19,858 35-watt lamps, whilst on December 31st, 1893, the number was 10,647. We also notice with pleasure that an agreement has been made with the Corporation of Leeds, under which the company will shortly commence to supply all the electrical energy required in lighting the Leeds Town Hall and Municipal Buildings, where lamps equivalent to about 6,000 35-watt lamps are installed. The following table gives the principal items of the report, and the detailed cost per unit :—

	1892.	1893.	1894.
Total capital invested	—	—	£56,476
Number of units sold	—	—	291,113
Number of lamps connected ...	—	—	19,858
Revenue from sale of current ...	—	—	£7,245
Net revenue	—	—	£3,709
Average price obtained per unit..	—	—	—

Cost of production.	£		Per unit.
Coal	708		·58d.
Oil, waste, water and engine room stores	214		·17d.
Salaries and wages at generating station	1,442		1·19d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	266	Works cost 2·15d.	·21d.
Rates and taxes	243		·20d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	900		·74d.
Depreciation of buildings and plant account	1,686		·14d.
Renewal fund account	nil		—
Total	£3,860		3·23d.

Revenue.		Average price obtained per unit.
By sale of current	£7,245 15 3	—
Meter Rents	84 17 1	—
Other items		
Total	£7,329 12 4	—

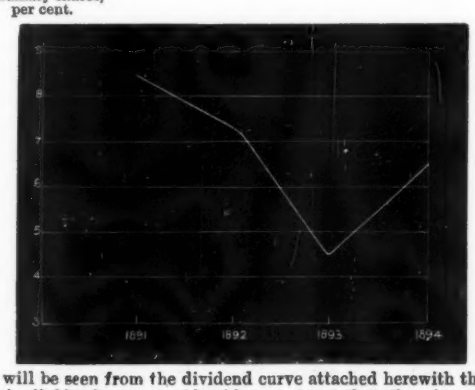
Total cost per unit, exclusive of depreciation account, 3·09d.; works cost, 2·15d.

The St. James's and Pall Mall Dividend.

We have great pleasure in announcing that the directors of the St. James's and Pall Mall Electric Light Company recommend a dividend at the rate of 9 per cent. per annum on ordinary shares for the half-year ending December 31st, 1894, making, with the interim dividend, 6½ per cent. for the year.

It is very gratifying to find such a speedy recovery, though we are not surprised; indeed, when last year things looked bad, we said that the company had sustained a temporary check, but that the economical working of the company would place it in its former opulent position.

Dividend on ordinary shares, per cent.



It will be seen from the dividend curve attached herewith that the drop in dividends was considerable; we trust that the rise may be quite as marked as the fall.

Anglo-American Telegraph Company.

The ordinary half-yearly meeting of the proprietors of the above company was held on Friday last, at Winchester House, Old Broad Street, under the presidency of the Marquis of Tweeddale.

The report and accounts having been taken as read,

The Chairman, in proposing their adoption, said that the traffic receipts for the half-year showed a decrease of £6,948 as compared with the corresponding period of last year; but that was not the first time they had had to lament a decrease in those receipts. The cause was the great stagnation that had prevailed in commercial and trading circles for a long time past. Some persons thought they saw signs of the approaching end of the depression, and he only hoped the belief was justified, or otherwise they could not look for any great increase in their traffic receipts. Fortunately, the expenses of the half-year, both at the head office and at the stations, showed a material decrease, amounting to £3,399. Had it not been for the expense incurred in laying a new cable, the board would have been able to pay the same dividend as they paid at the correspondiag period last year. The condition of the cables was, on the whole, satisfactory. The new cable was doing splendid work, and was quite capable of carrying the whole of the company's traffic. The 1873 cable and the 1880 cable were in fair condition, and the 1874 cable, which was repaired last year, was in good condition, save that it was interrupted in very shallow water on the Irish coast. The cable would be repaired without delay, as soon as the weather permitted their repairing ship to approach the coast. The Brest cable was certainly in no better condition than when he last addressed them, and told them they had grave doubts whether it was worth repairing, but they did not propose to come to any decision on that point until they were obliged. The renewal fund now amounted to £586,076, and he was glad to say that the market price of the investments in which the fund stood were £64,903 in excess of that figure. The securities which they sold to pay for the new cable realised a profit of £30,144. On the last occasion he referred to the desire which had been shown by both the Governments of France and Germany to lay cables to America independent of those already existing. He had no reason to suppose that those Governments had changed their minds as far as their desires were concerned, but he was not aware that any substantial progress had been made in giving effect to those desires. The French cable question was still *sub judice*. In July last the report informed the shareholders that although the decision of the French Court was generally favourable to the company, the directors considered that the limitation of the period within which damages were to be assessed, between December, 1886, and May, 1891, were unreasonable and unjust, and that they proposed to take counsels' opinion as to the advisability of appealing against that part of the decision, and they had accordingly lodged an appeal. It was impossible for him to say when the matter would be heard, but he hoped it would be decided before they met again. All they could do was to keep the company's property in a state of efficiency, and anybody who knew anything about the matter would, he thought, recognise that that duty had been carried out to the fullest extent, and no service in any part of the world exceeded theirs for punctuality and celerity. They had only to wait patiently for those better times, which he hoped and believed would come. At any rate he had this little consolation to offer them, that since the beginning of the year there had been a substantial increase in their receipts, and if the increase continued during the half-year, he had no doubt that at the next meeting they would be able to present a more favourable report than the one presented that day.

Mr. F. A. Bevan seconded the motion.

Mr. Griffiths and other Shareholders complained of the small dividend, and expressed the opinion that some limit should be put upon the renewal fund in the interests of the deferred shareholders.

The Chairman, in reply, said that with regard to there being a limit to the renewal fund, he would point out that before the new cable was laid it was approved by the shareholders that when the renewal fund had reached one million, no further additions should be made. They had not come to that time yet, for the fund was only £586,000, and nobody who knew anything about cables would consider that a sufficient sum as a renewal fund for a company like theirs. As to the French litigation, the shareholders might depend upon it that the directors would not go on with it unless they thought they were likely to get something out of it. As long as trade was dull traffics would be dull, and that was the experience, not only of themselves, but of all telegraph companies. With better times they might confidently look forward to an increased revenue.

The report was then adopted.

The Chairman and Mr. Charles Burt, the retiring directors, were re-elected, and Mr. J. Dean and Mr. John Gane, F.C.A., were re-elected auditors, and the proceedings closed with a vote of thanks to the chairman for presiding.

City and South London Railway Company.

The report of the directors for the half-year ending December 31st, 1894, to be submitted to the half-yearly ordinary general meeting of the company, to be held to-day, Friday, February 1st, at Winchester House, Old Broad Street, E.C., at 3 o'clock p.m, states that the receipts from all sources for the past half-year have amounted to £24,252 13s. 4d., and the cost of working has been £14,762 6s. 2d., leaving a profit of £9,490 7s. 2d. Inclusive of the balance brought forward from June 30th last, the net revenue account shows an aggregate total of £10,919 8s. 10d. After making provision for the debenture and debenture stock interest, a balance remains available for dividend of £6,771 12s. 10d. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference shares, and that a dividend at the rate of 1¼ per cent. per annum be paid upon the consolidated ordinary stock, leaving

a balance of £950 7s. 8d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

Half-year ended	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets).
		£ s. d.
December 31st, 1890 (11 days)...	165,000	1,568 3 9
June 30th, 1891	2,412,343	19,403 6 9
December 31st, 1891	2,749,055	19,798 16 6
June 30th, 1892	2,813,162	20,931 4 2
December 31st, 1892	3,117,692	22,002 17 5
June 30th, 1893	3,146,656	22,458 6 9
December 31st, 1893	3,093,351	22,067 14 10
June 30th, 1894	3,383,154	23,564 10 6
December 31st, 1894	3,275,649	23,540 12 4
Total since opening of the line	24,155,972	£175,335 13 0

During the past half-year there has been a very satisfactory and steady growth of the traffic during all hours of the day, but especially between 8 and 10 a.m. in the trains bringing passengers to the City. The trains between these hours have been considerably overcrowded, and as the small accommodation at King William Street Station prevents any increase in the number of trains run, a further advance in the fares during those hours has been made. This has had the effect of diminishing the overcrowding of the trains without seriously reducing the receipts. The substitution of motors on the train itself in the place of the present separate locomotives was found to be a more difficult operation than was at first expected, owing to the small size of the tunnels and the sharp curves near the entrance to the King William Street Station. After various experiments, these difficulties have at last been overcome, and a new motor car train has been satisfactorily completed, and has been approved by the Board of Trade. As this alteration will give an increased carrying capacity to the trains, it is proposed to proceed with the conversion of the existing stock as rapidly as the exigencies of the traffic will allow. By means of these motor trains there is every reason to expect that the increased traffic which may be anticipated during the present year will be able to be dealt with. But beyond that time there will be no means available for providing any further increase that may arise, though from the steady growth of the traffic in the past, such increase may be confidently expected. The directors therefore feel that the time has arrived when some steps should be taken to carry into effect the powers granted by the Act of 1893 for the extension to Islington. They would recommend that the line should, in the first instance, be extended to Finsbury Pavement only, the estimated cost of which is £280,000. The first steps to be taken in connection with this operation will be the acquisition of the sites for the stations at the south side of London Bridge, the Bank, and Finsbury Pavement, and as these negotiations are likely to occupy a very considerable time, the directors recommend that they be authorised to proceed with the purchase of these sites at once, leaving the question of the time for carrying out the works, and the most advantageous mode of raising the capital, to be discussed at a future meeting. This extension, when completed, would enable more than double the number of trains to be run, and a considerable increase in the accommodation of each train to be provided. The introduction of motor car trains will necessitate further siding accommodation at Stockwell, which it is proposed to proceed with at an early date. Mr. J. P. Court has given notice of his intention to move at the half-yearly meeting the following resolution: "That the remuneration of the directors be reduced to £650 per annum until the company pay a dividend at the rate of 2 per cent. per annum upon their ordinary stock." The directors have always been willing to concur in anything that they believed would further the true interests of the company. But, viewing the present resolution as practically one of want of confidence in the board, they trust the shareholders will show by their presence at the meeting, or by their proxies, their confidence in the present directors. During the past six months £9,100 of the terminable mortgage debenture bonds have been paid off, leaving a balance of £78,000 of the bonds to be dealt with as they fall due. As the powers for the purchase of land under the Clapham Extension Act of 1890 expire this year, it has been necessary to promote a Bill in Parliament for an extension of the times specified in that Act, and to sanction the raising of a small amount of additional capital to be expended on the new sidings at Stockwell and for other necessary works. There is also included in the Bill powers to enable the company to hold its half-yearly meetings in January and July, when the accounts can be prepared and presented to the proprietors at a somewhat earlier date than at present. The Bill will be submitted for your consideration at the special meeting to be held at the conclusion of the half-yearly meeting. The director retiring by rotation is Mr. Charles Grey Mott, who is eligible for re-election. The auditors retiring are Messrs. Turquand, Youngs, Bishop & Clarke, who offer themselves for re-election.

Direct United States Cable Company.

THE ordinary general meeting of the shareholders of the Direct United States Cable Company, Limited, was held on Friday morning last at Winchester House, Old Broad Street, E.C., Sir John Pender presiding.

The CHAIRMAN, in moving the adoption of the report, said that the revenue for the six months ending December 31st last, deducting out payments, &c., had been £38,342, whilst the working and other expenses, exclusive of cost of repairs to cables, had amounted to £19,024, leaving a balance of £19,318 as net profit, making with the amount brought forward £20,350 available for dividend. Interim dividends of 2s. per share had been paid in the two quarters, and after setting aside £3,400 pending settlement of disputed accounts in other companies, and £3,000 for the reserve fund, the balance, £1,807, had been carried forward. Compared with the corresponding period of 1893, the half-year's revenue was some £2,710 less, but on the other hand the expenses also were about £1,300 less. The cost of repairs to a short section of the cable had cost £1,612, which had been debited to the reserve fund account, which now amounted to £288,205. Their investment account had been increased by £9,441, and considerable appreciation had taken place in the value of the securities held. On the occasion of their last meeting when he addressed them, they had just added to the Atlantic group of cables a cable for the Commercial Telegraph Company, and immediately afterwards another was laid by the Anglo-American Company. They were laid on the best principles, and both had added considerably to the carrying of the traffic across the Atlantic. There was also talk about the German Government laying another cable, but that was much in the same position now as then. They must conclude, however, that when a government once made up its mind to lay a cable for commercial, political, or strategic reasons, sooner or later that cable would be laid. There had also been an amalgamation, or rather absorption, of the Pouyer-Quertier cable in France, by the French Telegraph Cables Company, which was an absorption by a poor company of one which had a little money, and that transaction had no doubt been induced by a promise, or half promise, of a subsidy by the French Government. So far that subsidy had not been granted, but it was being asked for on the plea of laying another cable from Brest to America in place of the one belonging to the Anglo-American Company, which had ceased to work. The Anglo-American Company found that the cable did not pay, and it was not likely they would go to the expense of replacing it; and in that case, if the French Company did lay another, it would not be an additional cable across the Atlantic, but only one to take the place of a cable which had ceased to work. In view of competition, however, they must look well to the work they had in hand. They had a powerful combination to carry on the Atlantic system; so powerful, that he might say there were at this moment more cables in the Atlantic than there was work to occupy them. As for their own, they were getting old, but they were doing all in their power to keep the service as thoroughly efficient as possible, and with a view to that they were increasing their reserve fund, believing they would be in a better position with a strong reserve fund when their cables gave out, than if they had to go to the public to raise fresh capital for a renewal. Both inland and marine telegraphy was absorbing a great deal of attention, and the world's commerce, politics, and social life, were largely sweetened by its aid, and a facility in such general use must be perpetuated; and, in fact, if the submarine cables of the present day were all broken, the world would seem at a standstill. Therefore it was an industry that must continue to exist, and they must be in a position to take their share of the work. In conclusion, the chairman referred to the death of Mr. Charles Meara, whose seat on the board they did not intend filling up.

The motion for the adoption of the report was seconded by Mr. C. E. GUNTHER, and it was carried without discussion.

Charing Cross and Strand Electricity Supply.—The directors of the Charing Cross and Strand Electricity Supply Corporation, Limited, have decided to recommend a dividend at the rate of 5 per cent. for the half-year ending December 31st, making, with the interim distribution at the rate of 4 per cent. in August, a distribution for the whole year of 4½ per cent. The balance, of upwards of £2,300, is to be applied to reserve, depreciation, &c.

British Volta Electric Glow Lamp Company, Limited.—The creditors of the above company are required on or before March 11th, 1895, to send their names and addresses and the particulars of their debts or claims, and the names and addresses of their solicitors, if any, to Albin Hunt, of Chesham, Bucks, the liquidator of the company.

New Issue.—The Great Northern and City Railway, incorporated with a share capital of £1,500,000, announce the issue of £1,000,000, the application list for which will close on or before Monday. We have already said that this line will run from Finsbury Park to Moorgate Street.

Submarine Cables Trust.—On and after February 1st, the sum of £1 5s., balance of the coupon due October 15th last, will be paid by Messrs. Glyn, Mills & Co.

Cuba Submarine Telegraph Company.—The directors recommend a dividend on the ordinary shares at the rate of 8 per cent. per annum, tax free, for the half-year ended December 31st.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending January 27th, 1895, amounted to £998; week ending January 28th, 1894, £951; increase, £47; total receipts for half-year, 1895, £3,999; corresponding period, 1894, £3,839; increase, £160.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending January 27th, 1895, amounted to £943; corresponding week last year, £632.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 25th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited were £3,412.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation January 23rd.	Closing Quotation, January 30th.	Business done during week ended January 30th, 1895. Highest.	Lowest
173,400*l*	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	101 —104	101 —104	...	...
1,012,880*l*	Anglo-American Teleg., Ltd.	Stock	£2 15s.	£2 11s.	...	41 — 42	41 — 42	41¼	...
2,993,560*l*	Do. do. 6 % Pref.	Stock	£5 10s.	£5 2s.	...	77 — 78	77 — 78	77⅞	77¼
2,993,560*l*	Do. do. Defd.	Stock	...	...	...	6½ — 7	6½ — 7	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½ % § §	6½ % § §	...	11¼ — 11¾	11½ — 12	11⅞	11½
75,000*l*	Do. do. 5 %, repayable June 1906	100	...	...	...	109 —113	109 —113	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	10% ‖ §	... §	...	2 — 3	2 — 3	2⅜	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	147 —152	147 —152	148	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % § §	2 % § §	...	1/16 — 3/16	1/16 — 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	13 — 14	13 — 14	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19½ — 20½	20 — 21	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4 %	4 %	...	4 — 4½	4 — 4½	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	...	9½ — 10	9½ — 10	...	...
30,000*l*	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	103 —106%	103 —106%	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½ % § §	2⅝ % § §	...	8½ — 9 xd	8½ — 9	9	8¾
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½ % § §	6½ % § §	...	16⅝ — 16⅝ xd	16⅝ — 16⅝	16½	16⅜
70,000	Do. 6 % Pref.	10	6 % § §	6 % § §	...	17 — 17½ xd	17¼ — 17⅜	17⅜	17½
102,100*l*	Do. 5 % Debs., repay. August, 1899	100	...	...	...	106 —110	106 —110	...	...
1,297,837*l*	Do. 4 % Mort. Deb.	Stock	...	...	...	122 —125	123 —126	124⅝	123
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	16⅜ — 16⅝ xd	16½ — 16¾	16¾	16⅜
54,100*l*	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	102 —106	102 —106	...	...
194,300*l*	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	103 —106	103 —106	104	...
320,000*l*	Do. 4 % Deb. Stock	Stock	...	...	...	123 —126	123 —126	124	...
95,100*l*	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	102 —106	102 —106	103	...
129,100*l*	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	103 —106	103 —106	...	...
300,000*l*	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	106 —109	106 —109	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	111 —114%	111 —114%	112	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅞ % § §	4⅞ % § §	...	9 — 9¼ xd	9¼ — 9⅜	9 1/16	9⅛
180,042	Do. do. 6 % Pref.	10	6 % § §	6 % § §	...	16¼ — 16½ xd	16¼ — 16½	16⅛	16¼
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅗ % § §	8⅗ % § §	...	21¾ — 22⅛	21¾ — 22¼	22¼	...
190,000*l*	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	107½	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	50 — 52	50 — 52	51½	50¾
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000*l*	Do. do. 6 % Debs.	100	...	...	...	105 —109	105 —109	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	⅛ — ⅜	⅛ — ⅜	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1½ — 2½	1⅝ — 2⅜	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	5 % § §	5 % § §	...	5¼ — 5⅜	5⅜ — 5⅝	5⅝	5¼
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 17	15 — 17	16¾	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	15 — 16	15 — 16	15⅝	15⅜
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5⅞ — 6⅛	6 — 6¼	6 5/16	6 1/16
1,100,000*l*	Do. 3½ % Deb. Stock Red.	...	...	...	...	104 —106	105 — 107	106	105¼
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	½ — ⅝	½ — ⅝	...	...
100,000*l*	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	104 —107	105 —108	...	...
11,839	Reuter's Ltd.	8	5 %	0 %	...	2 — 4	3 — 4	3 3/16	3¼
3,381	Submarine Cables Trust	Cert.	...	...	...	114 —119	118 —123	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1 — 2	1 — 2	...	...
146,733*l*	Do. do. 5 % Debs.	Stock	...	...	...	86 — 91	86 — 91	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	..	0 %	...	3 — 5	4 — 5	...	...
238,300*l*	Do. do. do. 5 % Debs.	100	...	...	...	101 —104	102 —105	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½ — 2½	1½ — 2½	...	...
150,000*l*	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	98 —103	98 —103	...	...
64,245	Western and Brazilian Teleg., Ltd.	15	2½ %	2½ %	...	10¾ — 11¼	10¾ — 11¼	11¼	11
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6¼ — 6⅝	6¼ — 6⅝	...	...
33,129	Do. do. do. 5 % Def.	7½	...	...	...	4⅜ — 5¼	4⅜ — 5¼	5¼	4¼
171,900*l*	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	103 —107	103 —107	...	...
214,800*l*	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	103 —107	103 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛ %	⅜ %	...	1 — 1⅛	1 — 1⅛	...	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10¾ — 11¼	10¾ — 11¼	10⅞	...
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	..	.	9 — 10	9 — 10	...	...
80,000*l*	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	108 —111	108 —111	...	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	115 —120	115 —120	...	...
166,900*l*	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	102 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	4½ %	...	4½ — 5¼	4½ — 5⅝	...	.
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	14⅛ — 15⅛	14½ — 15¼	15⅛	14⅞
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	15¼ — 15⅝	15¼ — 15⅝	15⅝	15⅝
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	132 —135	133 —136	134	133½
50,000	†Liverpool Electric Supply, all paid	5	5 %	5 %	...	7 5/16 — 7 7/16	7 5/16 — 7 7/16	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2 %	2½ %	...	9⅞ — 10¼	9⅞ — 10¼	10 1/16	9 15/16
100,000*l*	Do. 5% Deb., bonds of £10, £20, £40	...	...	...	...	... — ...	... — ...	...	...
150,000*l*	Do. 4½% first mortgage debenture stock	...	...	...	...	117 —120	117 —120	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	7 — 7½	7 — 7½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	7¼%	4½%	...	7⅞ — 8¼	7⅞ — 8¼	8⅛	7⅞
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	8⅞ — 9¼	8⅞ — 9¼	8 1/16	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	...	7½ — 8	7½ — 8	7 1/16	7 1/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Jan. 23rd.	Closing Quotation, Jan. 30th.	Business done during week ended Jan. 30th, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	6 % §	6 % §	...	2⅝ — 2⅞	2⅝ — 2⅞	2 13/16*	2⅝
90,000	Do. do. Non-cum. 6 % Pref, 1 to 90,000	2	6 % §	6 % §	...	2⅝ — 2⅞	2⅝ — 2⅞	2⅝	...
125,000/	Do. do. 4½ % Deb.	Stock	...	...	...	111 —114	113 —116	...	...
630,000/	City and South London Railway	Stock	⅝%	⅝%	...	44 — 46	48 — 50	49¼	45¼
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	...	3 — 3½	3 — 3½	...	...
50,000/	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	102 —107	102 —107	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼— ½	¼— ½	⅜	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½— 2	1½— 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd, 1 to 66,750 ...	2	*nil*	*nil*	...	1/16— 3/16	1/16— 3/16	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	1⅛— 1⅜	1⅛— 1⅜	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅝— 1⅛	1 — 1¼	1⅛	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	...	½— 1½	½— 1½	...	...
9,600/	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	...	...	...	6½— 7½	6½— 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	...	9 — 10	9 — 10	10	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	...	25½— 26½	24½— 25½	26	25⅝
200,000/	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	103¾	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	...	8½— 8⅝	8½— 8⅝	8 7/16	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13½	13 — 13½	...	...
	Swan United Electric Light, Ltd.	...	10 % §	7½% §	...	... — ...	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	...	41 — 43	41 — 43	43	...
150,000/	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	104 —107	104 —107	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2¼— 2⅜	2½— 2⅝	2 1/16	2⅛

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¼—5⅜.
Electric Construction Corporation, 6 % Debentures, 93—97.
Electric and General Investment, shares of £5 (£1 paid).
House-to-House Company (£5 paid), 2¼—2⅜.
Do. do. 7 % Preference, of £5, 6¼—7.
Do. do. 6 % Debentures of £100, 105—107.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 7—7¼; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.
Liverpool Electric Supply, £5 (fully paid), 6⅞—7.
London Electric Supply Corporation, £5 Ordinary, ¼—½.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 99—101.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4¼—4⅜.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

NEW SOURCES OF ELECTRIC POWER.

In treating of the above in the *Nineteenth Century*, Mr. Thwaite draws attention to the enormous wealth accumulated by the English people as a result of the large store of fuel and the energy with which this has been utilised, and he compares the discovery of the dynamo-electric machine with that of the steam engine. The discovery of the reversibility of the dynamo in 1873, he also considers of vast importance. It is, perhaps, stranger still that no scientific man had thought the fact out, for magneto rotary machines of the motor class are matters of old knowledge. True they were crude, and derived current from primary batteries and used mercurial commutators, but substantially they were electromotors, such as is the reversed dynamo. The dynamo and motor coupled by a wire of 112 miles in length, have shown what can be accomplished in electrical transmission, and point to the methods to be employed in the future. In this respect, Mr. Thwaite considers England to be behindhand, and he again points to the advantages to be gained by the consumption of fuel at a few centres and its conveyance to the districts where it will be used in light and power. The cost of 3,000 horse-power hours need not exceed £5 by the above system, as against £9 to £12 as now said to be the cost in London. On the one hand there is the loss in transmission, which is set down at 33 per cent. of the current, and against this there is the saving of carriage and the handling of coal, the saving of the imperfect small steam engine, and the saving in dirt and smoke and waste. There is also the possibility of recovering the ammonia and other products of combustion for use as manures, and so great will be the net saving in producing power, that 1 horse-power hour will be got from each ⅔ lb. of fuel. This will become 1 lb. by virtue of the loss in transmission to London from the Midland coal field. To cheapen as far as possible the cost of the project, the author proposes that special debentures should be issued upon the copper mains which will bear a low interest in face of so substantial an asset as non-wasting copper. If we are to have aluminium at the promised French price, the risk of dear copper, which such an extension of the transmission of electricity would bring about, may be checked and electricity be compelled to furnish its own mains.

At present there is little doubt but that coal does cost too much to carry by rail, that is we are charged too much for the carrying of it. There will, however, always be the loss in running back the empties, and the loss upon the carriage of the ash and clinker, some 5 to 10 per cent. of the coal.

The price of current is suggested at 2½d. per kw. to the supply companies who would be able to sell it for 3d. to 4d. Necessarily, Mr. Thwaite would use the gas engine as his prime mover and relegate the steam engine to the museum. The recent advance in the gas engine certainly gives promise of an early accomplishment of this hope. Imperfect as is the gas engine, and shamefully unscientific as is the use of a heat engine with a water-jacket, nevertheless, the steam engine has also a water-jacket round its place of heat generation, and, moreover, does not use heat of higher degree than that of the water-jacket. The gas engine, however, does commence with a higher degree of heat and probably could be made to exhaust at a degree very much lower than it does now, whereby its efficiency might be made even better than it is. To bring the long distance transmission into effect there is needed a good means of obtaining heat from the electric current and some more energy in the electric supply companies. At present they are doing absolutely nothing to make electricity the poor man's light, such as it is claimed to be by Mr. Preece. The poor man rubs along with gas. If he gets sick of the dirty gas supplied by the gas companies he tries oil. He is tempted to try the Welsbach light but hears of the monoxide product and fears the tenderness of the mantle, and all the time with incandescent electric lamps at one-tenth the price of Welsbach burners the electrical supply companies are in tears because their load is not what it should be.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

The Origin and Development of the Telephone Switchboard. By J. E. Kingsbury, Associate. Read Thursday, January 24th, 1895.

The telephone itself has been the subject of various papers read before this Institution, but the same remark does not apply to apparatus which has become allied with the telephone in its commercial applications. The most important of such apparatus is the switchboard used in exchange service. It is because this subject does not appear among your records that I have treated it in the manner indicated by the title of this paper. To those who have been long engaged in telephone work, such a title will not raise expectations of novel information, or suggest exhaustive treatment. To those who are not, or have not been, so engaged, I can only hope that it may be of interest

to the same extent that it is of interest to trace the development of any enterprise or apparatus.

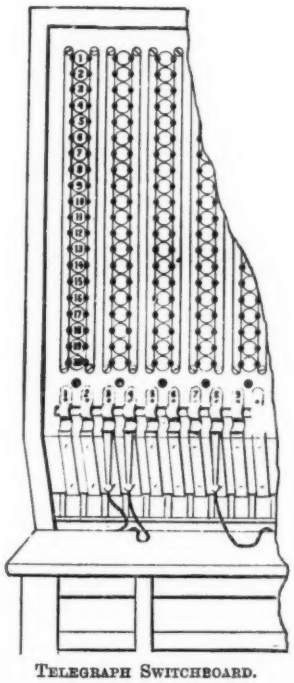
The switchboard has been described as the brain of the telephone system. In seeking anatomical similes, I hardly know whether to choose the brain, the heart, or the backbone. It is the brain in so far that it is the nerve centre, all communications going through it; it is the heart in that it is the life of the telephone system as we know it to-day; and it is certainly the backbone—of the exchange business.

The telephone, itself a marvel of simplicity, has become involved in a network of considerable complexity known as an "exchange system"—a means of intercommunication of which the switchboard is the centre-piece. The exchange system seems necessarily identified with the telephone, but it existed before the telephone was invented.

I am indebted to American sources for the information that the first idea of exchange working is to be found in a British patent granted to an inventor bearing a French name. Mr. T. D. Lockwood says: "The first idea of exchange work which, to my knowledge, occurs in history, is found in a British patent, issued as far back as February 7th, 1851, to F. M. A. Dumont. This clearly describes an exchange system of dial telegraph instruments, connecting by short lines with branch central stations, which branch stations were provided with trunk lines connecting them with a principal station." Mr. Lockwood remarks that "the idea was far ahead of the times."—(Tel. Con. Rep., 1887, p. 50.)

At Newcastle, the Post Office arranged a system of connecting subscribers provided with Wheatstone A.B.C. instruments. In New York, such a system was introduced in 1874 or 1875. The founder of that system was not aware that inter-communicating exchanges had previously existed. He had observed the success attending the telegraphing of stock quotations to subscribers, who each received identical information despatched from a central office, just as is done by the Exchange Telegraph Company here, and he assumed that a like success might be obtained by furnishing information to legal firms as to the course of proceedings in the Courts. The legal firms did not take kindly to the idea, but one of them offered an alternative suggestion, intimating that a system which would enable lawyers to communicate with each other by telegraph would be worth paying for. Confirmation of this idea was obtained from others, and the result was the establishment of a telegraph exchange. As the exchange was exclusively used by legal firms, the company was called the "Law Telegraph Company." Telegraph instruments were subsequently replaced by telephones, and the particular system adopted for working the exchange became known as the "Law" system.

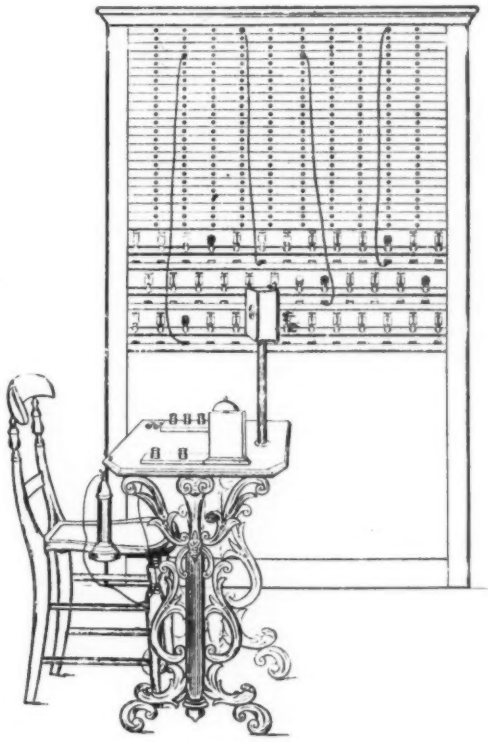
Notwithstanding that this telegraph exchange was already in existence at the time of the invention of the telephone in 1876, it was not until January, 1878, that the first commercial telephone exchange was started. In the meantime, Bell's invention had been greatly improved, and shortly afterwards the introduction on a commercial scale of the Edison carbon telephone and the Blake transmitter—an early and admirable modification of Hughes's beautiful discovery—placed telephony upon such a practical basis that its progress became assured. It was the microphonic era when was commenced that activity in telephone exchange work which necessitated attention being given to switching mechanism.



Telegraph Switchboard.

In addition to the public exchange system, every large telegraph office was the centre of numerous lines, which were connected together as required by means of a switchboard. Part of a well known telegraph switchboard is illustrated here. It consists of vertical and horizontal bars, the vertical bars being the lines, the horizontal bars providing the means of connecting any one vertical line with another by inserting plugs. The vertical lines terminate in springs resting on contacts. A telegraph instrument can be looped into circuit by a double contact plug inserted between the spring and its contact. These springs were known to telegraphists as "springjacks." Those who started telephone exchanges, like all other founders of new industries, adopted, in the first instance, that which already existed, so far as it was, within their knowledge, available for their purpose. All the first telephone switchboards have been traced by competent hands to a telegraphic origin. Hence the origin of the telephone switchboard is the telegraph switchboard, with the addition of indicators already in use for signalling purposes.

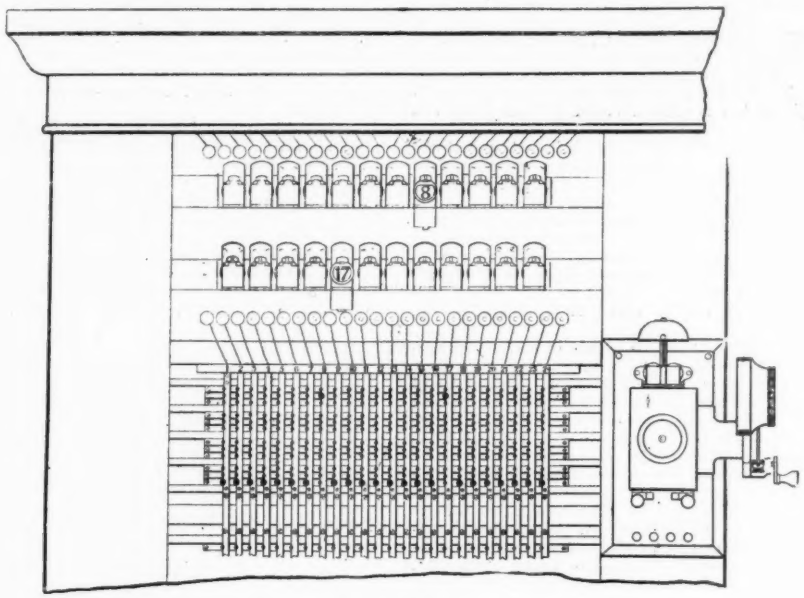
It will be remembered that telephone exchange business was started almost simultaneously in London by two different organisations—the Bell and the Edison Companies. The Edison Company had an experimental exchange at No. 6, Lombard Street. It was publicly opened on September 4th, 1879, with 10 subscribers connected. The switchboard then used formed the subject of the first specification for a telephone switchboard in the English Patent Office (No. 3,794, September 20th, 1879). The elevation drawing attached to that specification is here reproduced. The switchboard used by the Bell Company in their first exchange at 36, Coleman Street, was of a different character. The sketch shown is made from a photo-



Bell Board.

graph in my possession. It is a rather curious circumstance that these two drawings, in addition to showing the first switchboards used simultaneously in English telephone exchanges, are also examples of two types of board, viz., plug boards and cord boards, of which there were several varieties. The "Edison board"—as it is called here, because it was used by the Edison Company—is practically the same as the upper part of the telegraph switchboard. The vertical strips are continuations of subscribers' lines; the horizontal strips are normally insulated from the vertical strips; but any vertical strip may be placed in electrical contact with any horizontal strip by placing a metal plug in the hole which is drilled at the point of intersection. Another metal plug similarly applied will place the same horizontal line into electrical connection with any other vertical line. Thus two subscribers' lines are connected together by means of a cross bar and two metal plugs. There are no flexible cords whatever; even the speaking instrument is connected to a rigid bar. A different method is followed in the board used by the Bell Company, and consequently called here the "Bell board." The cross bars remain, but the vertical bars are dispensed with. The subscribers' lines end in a springjack like the lower part of the telegraph switchboard, connections being made by means of flexible conducting cords, having suitable plugs at each extremity. The one, therefore, is a plug board, the other a cord board; and for a while these two types provided the necessary material for the holding of opposite views amongst practical telephonists. The plug board was preferred because it was free from the liability of broken cords, had its construction and circuits readily traceable, and also, perhaps, because it was generally more in accordance with previous practice in switches. The cord board, however, had greater flexibility and possibilities of concentration.

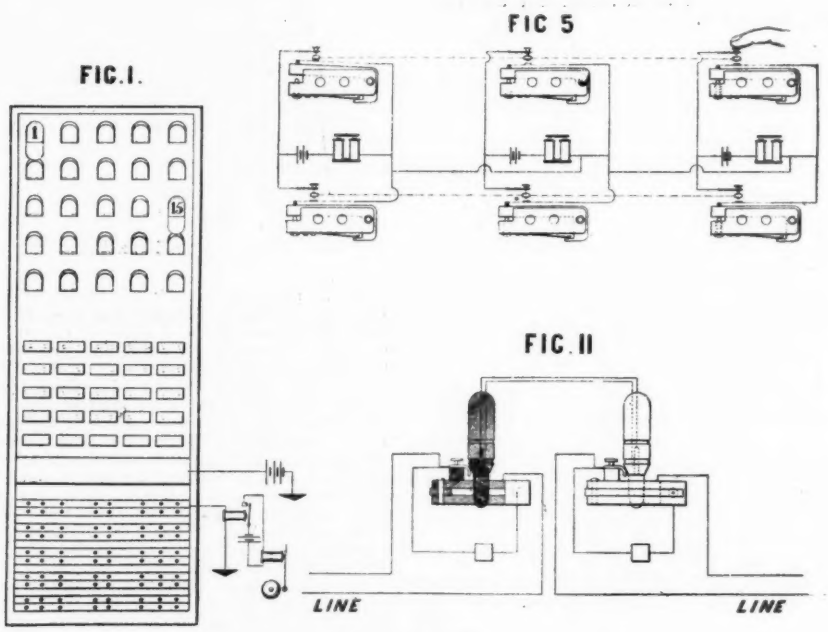
Numerous varieties of plug board were made, differing considerably in appearance, but having exactly the same method of working. It is not possible for me, in the time at my disposal, to describe in detail the various differences. It will suffice to say that the general idea was the same; the differences were either in construction, or in the method of connecting the vertical with the horizontal bars. In some the plugs were loose, as in the one shown; in others—as in those originally used, I believe, in Manchester and Sheffield—the connecting plugs slid over a rod with notches for each horizontal bar, and were held in place by a spring clip fitting into the notch. These are merely differences of detail, and need not now be considered. It is of more importance to trace the methods of operation.



Edison Board.

In the Edison board, whilst the majority of horizontal bars are free for use as connecting strips, two of them are appropriated for specific purposes. The seventh bar is connected to the operator's telephone, the twelfth bar to the earth. In order that each subscriber's line may be complete, so that the exchange may be called, the plug must be normally in contact with the earth bar. When the fall of the indicator shutter shows that a subscriber is calling, the plug has to be taken out of the earth bar and set into the instrument bar. When the number of the subscriber required has been ascertained, the peg has to be again removed from the seventh, or instrument bar, and set into one of the other horizontal bars which may be unoccupied. The peg of the called subscriber is also removed from the earth bar and placed in contact with the horizontal bar already selected. The two subscribers' lines are then connected. No provision being made for ringing from the exchange, one subscriber calls the other. This act throws down both indicators, which the operator must replace.

In the Bell board the work is divided between two operators. One does the switching, the other the talking with the subscriber. The switching operator connects the subscriber with the table of the talking operator, who, upon learning the number required, instructs the switching operator to make the necessary connections, which he does with the flexible cords. Without detailing the various movements, it will suffice to draw attention to one point. The subscriber's line comes to a spring, and the spring rests on a contact. The contact is the earth. The plug with which connection is made is insulated on the under side, and removes the line from the earth; and



Scribner, 1879.

that is one step in advance of the Edison board. A line needed to be broken and diverted. These requirements were separately met in the Edison board, whilst in the other case they were combined. In the development of telephone switchboards, that is equivalent to making two blades of grass grow where one grew before.

The cord board offered facilities in this direction which the peg board did not. According to the (American) Telephone Convention Report for 1883 (p. 33), plug boards were the most popular in 1881, there being amongst the companies reporting to the association 11,904 subscribers on plug boards, and 8,893 subscribers on cord boards. By 1882 the conditions were changed, cord boards having 16,799 subscribers, and plug boards 12,755. By 1883 the change was shown to have some substantial foundation, the figures being 21,432 for cord boards, and 12,763 for plug boards. These figures do not refer to the identical boards illustrated here, but to all varieties of their respective types. They show that the intervening period was sufficiently active and exacting to have had some influence in deciding which was the fittest type of board for survival. That type was the cord board, and it may be desirable now to trace briefly the development of the most generally used form of cord board for small exchanges.

For this purpose it is necessary to call your attention to a patent specification, which I think may be called a classic in this branch of invention. It is dated November 29th, 1879, numbered 4,903, and granted to C. E. Scribner. In fig. 1 is represented a board known as the "universal jack-knife switch." There are the indicators and the individual connecting springs for the lines as in the Bell board, but arranged in distinct groups, and there are the horizontal connecting bars also. Although there are these points of similarity, there are improvements over each. In the Bell board you will notice the indicators and jacks are mixed up together, and the cords have to pass the indicators, but in the universal jack-knife switch the indicators are separated from the jacks. Both are arranged in distinct groups. In the Bell board the line comes to the indicator first, then through the springjack to earth. Inserting a plug into the springjack cuts off the earth, but the indicator remains in circuit. Scribner cuts off both drop and earth in one operation, by the simple device of putting the drop the earth side of the jack, so that both subscribers' indicators are cut out of circuit instead of both remaining in. This is another step forward. The horizontal connecting strip is also improved by being turned round when engaged. This facilitated the selection of a disengaged connecting strip, but was not Scribner's invention.

In connecting the two subscribers' lines together, two cords were used, as in the Bell board, each cord having a plug at either end, and the calling subscriber's line was connected to the revolving bar by one cord, and the same revolving bar connected to the called subscriber's line by the other cord. But, as both subscribers' indicators were cut out, some provision must be made for the reception of a disconnection signal. This switchboard brings us one more step forward in the inclusion of signalling apparatus in the connecting cords or bars at the central office. And I would invite particular attention to the way this was done, because I think that it has been overlooked by some writers on telephone subjects. To each bar an indicator was connected in derivation, one end of the coil being connected to the bar, and the other to earth. The specification says: "The earth connection of the coupling bar being through the coils of a magnet, in no way interferes with the telephonic conversation;" which remark you will apply to the lines then prevalent with the electro-magnet then used. The clearing out indicator, as illustrated, was not mounted on the switchboard—there was a relay operating an audible signal; but a complete indicator is allowed for in the description. Although a clearing-out indicator was connected to the central office circuit, the operator's telephone was still at the extremity of a separate cord, and needed to be plugged into or out of a spingjack, in order to be brought into or out of the subscriber's line circuit.

The circuit made up by the operator for the purpose of joining two subscribers' lines consisted of two cords and a bar. There were the operations of putting two plugs into springjacks, and two plugs into a bar. If the two cords were permanently attached to the bar, a part of the work would be saved. If, further, the operator's telephone were to be switched into or out of the line by a key, the operations required would be more quickly performed.

The rapidly increasing numbers in the exchanges rendered the bar system impracticable, whether of the fixed or revolving pattern. The bar therefore was discarded; the cords were lengthened, joined together, and the circuits so arranged that the ringing battery or generator, the operator's telephone, or the clearing-out drop, could be brought into use as required by the easy manipulation of keys placed in the most suitable position. This stage was reached in the switchboard now generally known as the standard switchboard. Its development dates from 1879, the germ being found in the universal jack-knife switch. The keyboard was an entirely new feature in switchboards, and was the logical result of the combination of connecting cords and plugs with clearing-out drops. The arrangement of the parts was strictly decimal—an obvious advantage hitherto neglected. The decimal arrangement is not shown in fig. 1 of Scribner, 1879. The standard board was first made for 50 lines, with indicators five across, as in the illustration, but 10 deep, and the numbering was in columns downwards. That arrangement continued for some time, but was eventually changed to the numbering in lines as now adopted. Some of the keyboard circuits, being also applicable to multiple boards, were patented here, such as that shown in fig. 2 of Specification No. 3,116, 1883, whereby the operator's telephone is in circuit immediately a plug is inserted in a jack. This is done by means of the other plug of the pair resting on a plate to which the telephone is connected, and accounts for the metallic heel-piece to the plug which then came into use. This board has been greatly altered in the parts of which it is composed, but in general arrangement and in the methods of operation very little, if any, improvement has been found possible, and for small exchanges it has been extensively adopted, or imitated substantially in its original form. Sufficient thought had been bestowed upon it to enable it to assume a form based on sound principles. The board was upright, with a shelf for keys and plugs. What was needed to be seen or handled was placed in the front of the board, but nothing else. All the connecting wires were placed at the back of the board, so that they could be attended to by the mechanic without interfering with the operator. The importance of this arrangement is very apparent now.

The introduction of the standard board probably accounts for the figures which I have already referred to as indicating the change in general estimation of plug and cord boards. Although the flexibility and concentration available with cords must have led to their general adoption, it is of interest to note how the placing of the operator's telephone into the cord circuit overcame one of the principal objections to cords. The existence of a broken cord must become known to the operator in the process of making a connection, and it could therefore be laid aside for another.

Whilst the standard board remains the most effective of what may be called "simple" switchboards—that is to say, those in which a subscriber has only one springjack or point of access to his line—it also forms in its constructive and keyboard arrangements the foundation for the more elaborate multiple board, which, although previously invented, soon borrowed the general disposition and the simple and practical mode of operation of the standard board.

The multiple board as originally designed employed the Scribner "jack-knife" switch, which was never used in England, I think. It consists of a metallic frame, with a blade pivoted at one end, and resting on an insulated stud at the other. There are two holes. These are for plugs—one for the instrument plug, and the other for the connecting plug. The insertion of either plug will lift the blade from the stud, and so break the earth and indicator contact. The importance of space on the front of a switchboard led to a change in the jack-knife switch at an early date. Instead of lying lengthwise across the front of the board, the blade or spring followed more after the fashion of the spring in the Bell board—*i.e.*, having its length from the rear to the front instead of from side to side. Though entirely different in appearance and construction, the modified switch was the equivalent of the jack-knife electrically. Whilst previous springs, as in the Bell board, were operated by flat plugs, the designer of the new springjack retained the round plug as used by Scribner, altering the shape so that it should be retained in position by the tension of the spring. This springjack and plug remain in their essential features the patterns now in use. The adoption of a round instead of a flat plug may seem a small matter, but it would require a very considerable amount of calculation to estimate the aggregate saving in time and money which has resulted therefrom.

It may be of interest to state that the inventor is Mr. J. C. Warner, one of the oldest of the expert staff of the Western Electric Company. Mr. Warner designed not only the jack, but also the indicator used on these switchboards. He brought to the design of telephone apparatus a wide experience, and you will probably agree with me that he graduated in a good school. Born in London in 1822, Mr. Warner became engaged in the manufacture of electrical apparatus in the workshop in which instruments were made for Cooke and Wheatstone. Subsequently he made some apparatus for experimental use by Morse on the line between Baltimore and Washington.

Having traced the simple switchboard to the stage in which it is supplied with an indicator and a springjack for each line, with pairs of plugs and connecting cords in whose circuit are placed convenient keys whereby the calling generator and the operator's speaking instruments can be quickly brought into circuit with either subscriber's line, consideration may be given to the more elaborate outfits required for large exchanges. It was on such a foundation that the multiple board was practically introduced, though it was designed at a much earlier period, and was being gradually matured.

(To be continued.)

NEW PATENTS—1894.

856. "Improvements in telephonic transmitters." J. H. Salter. Dated January 14th.

867. "An improved electricity meter for registering the amount of current consumed on direct or alternating polyphase, triphase, or quadruplephase circuits." F. J. Beaumont and F. Hallows. Dated January 14th.

883. "Production of liquid ammonia by electricity." R. W. Hill. Dated January 14th.

884. "An electric alarm and detector of oxygen gas." R. W. Hill. Dated January 14th.

890. "An electrical ballet." A. Cannot. Dated January 14th.

962. "Improvements in and relating to electric railways, and apparatus therefor." C. F. P. Stendebach. Dated January 15th.

1,000. "Improvements in and relating to conduit electric railways." W. T. Dulany, jun., and O. F. Shaw. Dated January 15th. (*Complete.*)

1,012. "An improved electrical device for lighting and extinguishing incandescent gas lamps." W. P. Thompson. (Communicated by J. Bilfinger, Germany.) Dated January 15th. (*Complete.*)

1,028. "Improvements in kinetoscopes." A. Lomax. Dated January 16th.

1,085. "Improvements in electrical apparatus for lighting and extinguishing gas burners." A. ORLING and O. E. WOLLERT. Dated January 16th.

1,088. "An improvement in safety fuses for high-tension electric currents." SIEMENS BROS. & CO., LIMITED, and F. HIRD. Dated January 16th. (*Complete.*)

1,115. "Improvements in kinetoscopes." J. ANDERTON and A. LOMAX. Dated January 17th.

1,116. "Improvements connected with boats and vessels propelled by electricity." R. MCLAUCHLAN MCDONALD and A. MCDONALD. Dated January 17th.

1,117. "Improvements in electric batteries." R. MCLAUCHLAN MCDONALD and A. MCDONALD. Dated January 17th.

1,120. "Improvements in telephone circuits and apparatus appertaining thereto." A. ECKSTEIN and R. P. EIDSFORTH. Dated January 17th.

1,164. "Improvements in typographic telegraph apparatus." A. DAMASKINOS. Dated January 17th. (*Complete.*)

1,180. "Improvements in solutions for use in primary batteries." H. LEVETUS, E. M. LEVETUS, W. ROWBOTHAM and C. LEVETUS. Dated January 18th.

1,181. "Improvements in solutions for use in primary batteries." H. LEVETUS, E. M. LEVETUS, W. ROWBOTHAM, and C. LEVETUS. Dated January 18th.

1,202. "Improvements in telephonic apparatus." W. E. LANGDON. Dated January 18th.

1,206. "Apparatus for measuring and recording electrical currents." J. FRIENDS and T. J. MURRAY. Dated January 18th.

1,234. "Method of varying the speed of multipolar electric motors." J. A. ESSBERGER. Dated January 18th.

1,260. "Self-inductor current alternators." P. BOUCHEROT. Dated January 18th.

1,262. "Improvements in electric arc lamps." W. J. DAVY. Dated January 18th.

1,279. "An automatic resistance coil for the regulation of electric currents." S. S. ALLIN. Dated January 19th.

1,296. "Improved India-rubber cushions for portable storage or other batteries." J. PITKIN. Dated January 19th.

1,317. "Improvements relating to electric lamps." R. HACKING, and G. BRAND. Dated January 19th.

1,318. "Improvements in armatures for dynamo-electric machines." R. E. B. CROMPTON, S. L. BRUNTON, and P. PRIVEIT. Dated January 19th.

1,353. "Improvements in the application of telephones to electric bell systems." F. HODGSON, and G. A. EDWARDS. Dated January 19th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1894.

140. "Improvements in telephone exchange systems." R. CALLENDER. Dated January 2nd. Relates to 1st, an improved automatic exchange apparatus and method of operation whereby any subscriber may obtain control of one section of the switching apparatus instantaneously, and to the exclusion of all other subscribers from the use of that particular section for a brief space of time sufficient to effect the desired connection, and then through the mechanism thus actuated to automatically disconnect the section of switching mechanism used and leave it for the use of any other subscriber, while he (the first named subscriber) continues his conversation unmolested with the subscriber called, and at the end of that conversation restores his line and the line of the subscriber to whom he is talking, to normal condition, the arrangement being such that if need be, an indefinite number of the entire list of subscribers might call and talk simultaneously with a like number of outlying subscribers and in such manner that there would be no delay in signalling, nor interference of any kind whatever at any point. 2nd. A method and means whereby if a subscriber when called is using his line, any such calls are stored up one after another and then sent in to the first named subscriber automatically and in the order stored; the sequence of connections to the various lines being effected in the order in which they are stored. 3rd. An automatic recorder which is located at the exchange and operatively connected with any subscriber and adapted to make a record of all calls made by all subscribers connected to it, thereby acting as a check on the actual number of calls made. 4th. To the details of construction of the entire apparatus. 123 claims.

3,729. "Improvements in dynamo-electric machines." E. A. CLAREMONT. Dated February 21st. Claims:—1. In the construction of dynamo-electric machines, the use of pole pieces that are formed with divisions in the manner and for the purpose substantially as hereinbefore described. 2. In dynamo-electric machines the construction of the armature by means of a combination of wires laid in grooves formed in the periphery of the disc, and wires laid on the periphery of said disc, in the manner and for the purpose substantially as described.

4,083. "Improvements in electric arc-lamps." K. SCHLEYDER. Dated February 26th. Consist of 1, a short metal tube provided with two slits; 2. An iron core adapted to move up and down in the said tube its vertical oscillations being communicated by a cross-piece to rollers and levers; 3. Bent levers arranged to pivot or rotate easily on fulcra and carrying at one end rollers and at the other end insulated carbon-holders as well as arms carrying movable weights which serve to counterbalance the entire mechanism; 4. A brake-apparatus for the iron core devised to prevent any backward (or downward) movement of the core whereby the carbon points would be separated; 5. A solenoid of inconsiderable resistance. 3 claims.

4,144 "Improvements in electrodes for arc lamps." E. O. CLARK. Dated February 27th. The carbon electrodes are coated as usual with a film or covering of copper, and after the electrode has thus been covered, another coating of a metal, differing in nature from copper, is applied mechanically or by chemical or electrical deposition upon the copper coating, so as to cover the same. 5 claims.

4,197. "Improvements in or connected with bases and covers for electric switches and fuses." F. W. BUSCH. Dated February 27th. Consists in employing a bayonet joint instead of a screw thread. 4 claims.

9,117. "Improvements in and relating to electro-magnetic tools." P. JENSEN. (A communication from abroad by A. G. Fonda, of Louisville.) Dated May 8th. Has relation to certain new and useful improvements in electro-magnetic tools, wherein a hammer rod or plunger is actuated to a rapid reciprocating movement under the influence of a pair of electro-magnets upon an armature which carries said rod or plunger, said armature being situated between the like poles of said magnets, and itself carrying a coil energised by an alternating current. 1 claim.

10,393. "Improvements in arc lamps." E. A. CLAREMONT. Dated May 29th. Relates chiefly to an improved form of electro-magnet and armature, whereby the leakage of the lines of force between the polar faces of the magnet and the armature is very materially decreased, and consequently the sensitiveness of reaction of the one upon the other is greatly increased. 3 claims.

11,100. "Improvements in electric dental motor apparatus." F. N. DENISON. Dated June 7th. Consists, essentially, in the construction and arrangement of a swinging table motor, supported within the case of the same, and communicating motion to the dental engine, switches, and other parts of the apparatus. 22 claims.

11,219. "Incandescent electric lamps, and sockets therefor." C. A. HUSSEY. Dated June 9th. The objects of the invention are, first, to make the construction of the lamp simple, and as nearly as possible similar to the single filament lamps now commonly in use; second, to provide a socket of simple construction, to receive the lamp; third, to provide both lamp and socket with suitable contact pieces, which shall be in contact when the lamp is in place within the socket, and which shall be adapted to convey current to the lamp filaments, or to one of them, in any desired manner, without danger of short-circuiting; and fourth, to provide a suitable switch which shall be able to connect the lamp filaments with the wires for supplying current either singly, in series, or in multiple, which shall be of a size such that it may be placed within a lamp socket of usual size, which will be simple and cheap in construction, easily operated, and which shall not be liable to derangement. 12 claims.

11,418. "Improvements in telephone transmitters." J. E. KINGSBURY. (A communication from abroad by the Western Electric Company, of Chicago.) Dated June 12th. The inventor employs slate as the material for the casing and side wall of the variable resistance button, and mounts the front or vibratory electrode of the said button on a supporting disc of fine gauze. 5 claims.

11,664. "An improved method, means, or process of producing caustic soda and chlorine gas, or caustic potash and chlorine gas, by the electrolysis of common salt in solution, or chloride of potassium in solution." T. DRAKE. Dated June 16th. The inventor uses an electrolytic cell containing two chambers, and also a porous pot, surrounded with wire, wire gauze, or perforated sheet metal, together with electric currents. 5 claims.

12,131. "Improvements in electric brake-operating mechanism for vehicles." L. E. FREEDLEY. (Under International Convention.) Dated December 29th, 1893. Relates especially to mechanism for transferring the electric current from the drive motors of electrically propelled street cars to a supplemental motor whereby the brake mechanism of the car may be actuated, it being designed particularly for use in case of accident or sudden emergency, where it is essential to set the brakes with more rapidity than is practical with the ordinary hand-power brake. 9 claims.

12,349. "Improvements in or relating to heating metals electrically." W. P. THOMPSON. (A communication by C. L. Coffin, of America.) Dated June 26th. Consists in heating the metal, connecting it with one terminal of a generator of electricity, bringing it in contact with a liquid electrode connected with the other terminal of said generator, and establishing a voltaic arc between the two electrodes. Also consists in heating the metal previous to its immersion in a liquid electrode, connected to one terminal of a source of electric energy, the said metal being connected to the other terminal of the source of electric energy, and establishing a voltaic arc between the electrodes. Also consists in dipping a heated piece of metal into a liquid, passing an electric current through said metal and liquid, and establishing a voltaic arc between said electrodes. 3 claims.